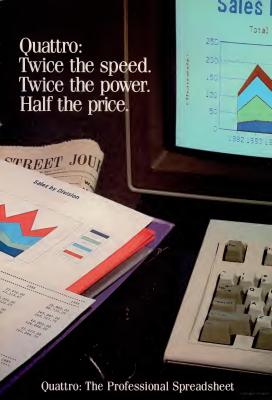




13

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1957

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	FEATURE	QUATTRO	LOTUS 2.01
SPEED	ReCelc Cash Flow Model (SK cells)	.27	2.90 sec
	Delete Row 15K calls (Recalc Time)	.76 sec.	2 36 sec
	Load File (15K cells)	15.9 sec.	19.8 sec
	Page Down (A1 to A1000)	12.2 sec.	17 4 sec
GRAPHICS	Presentation-quelity Graphics	YES	MO
	Graph Types	10	6
	Integrated Graph Printing	YES	NO.
	Full Graph Customization	YES	NO
	On-Screen Forn Styles	11	1
	PostScript Support	YES	NO
П	User-modifiable Menus	YES	NO
È	Menu Shortcuts	YES	NO
VERSATILITY	Pull-down menus	YES	NO
VER.	Point and Press Editing	YES	NO
1	Automatic installation	YES	NO
-	Macro Learn Mode	YES	NO
POWER	Maximum Number of Megros	United	27
٤	Single Step Macro Debugging Environment	YES	NO
П	Pries	\$199.95	\$495

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Joe was one of those leading edge kind of guys.

But most of his reports and sales presentations looked like they were done on a typewriter.

It was a case of 21st century computer thinking trapped in a 1935 typeface.

Joe knew if he was ever going to be a success he'd have to control his LaserJet."

One jet jockey's quest to be captain of his ship.

The following day was spent scouring the computer stores for a way to upgrade. But to no avail. Until he stepped through the door of one of those high-tech boutiques. "Sure, JetWare" makes it,"

"Sure, JetWare" makes it," the bearded guru replied to Joe's query. "Their fonts are designed by technology specialists, not hardware manufacturers."

Real typefaces deliver the Laser's edge.

When Joe left the store his arms were piled high with Jeff ront." cartridges. There were cartridges for upgrading his Laser Jet from typewriter faces to real faces like Helvetica Bold for headlines and Times Roman for body copy.

There was a cartridge that would bring smiles to his company's overseas offices. It had all the international characters on it. There was even a JetWare cartridge that had all the classic spreadsheet fonts.

And JetWare fonts had the look of typeset. They were cleaner, more consistent and came with attractive proportional spacing as well as fixed pitch.

This was the stuff of which heroes were made. And they were fully compatible and backed by the reliability of CPI.

Lotica reduces Lotus spreadsheets to letter size.

But what really made Joe the talk of the office was his discovery of JetWare's new 123™

cartridge that lets you squeeze 40,000 characters on a single 8½ x 11 sheet. It helped shrink the job of doing 1-2-3** spreadsheets down to size. The secret of its success was "Lotica," a special typeface designed by Jet Ware that was so sharp it could be almost

infinitely reduced and still be legible.

Now that was space age! It meant
the end of the dot matrix printer
and all the cut and paste nonsense
that went with it.

Joe was so hyped, he wanted to do more. His mind turned to graphics. But to accomplish

what he wanted, he knew he'd have to find a way to get more memory into his LaserJet

JetWare's incredible shrinking technology expands memory, improves reliability. There it was right on

the shelf One of the hottest new products to hit the market. JetMemory** JetWare had reinterpreted the memory card. Shrunk it down to size. And with the help of surface mount technology, they managed to get two cards to fit into the space HP had allotted for one. You could add memory without discarding expensive memory cards.

It was maximum economy.

The bright future. JetFont, JetMemory and Joe.

With every new success Joe's fame grows. They know him from the tall towers of corporate headquarters where they pour over his spreadsheets and plan strategic takeovers... to the tranquil field office in India where they meditate on the beauty of Joe's stylish pitches.

Now, wherever intelligence, fortitude and perseverance are appreciated, they talk of Joe. The man they call "Captain Jet."

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If JetWare products haven't landed in your area call (800) 854-7600, in California (806) 489-5751. or write 667 Rancho Conejo Blvd. Newbury Park CA 91830.

The Fast Cure For A Slowing Hard Disk



"Vopt is something of a miracle, it performs its disk reorganization chores in seconds, instead of the minutes and aven hours some other utilities can take.

...a bargain. Vopt is fast, safe. affective, and even fun to usa. What more could you want?"

Glenn Hart, PC Magazine May 12, 1987, Page 36.

"The overall afficiency of my computer system was significantly improved."

William G. Harrington. The National Law Journal June 29, 1987, Page 14.

Vopt gives you faster hard disk access in seconds!

When DOS creates a file, it scatters file fragments over the disk surfaces. It takes time to collect those fragments when you need the data, so your system runs slower and slower as your files grow more fragmented.

Vopt organizes your files the way DOS should have written themcontiguously-so file retrieval is easy and fasti

\$3 shipping/handling. \$49.95 CA add 6% sales tax.



with DOS systems, including PS/2, with 512Kb RAM

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WHAT'S INSIDE

Good news for PC users who travel: there's a whole new crop of portable computers that raise the standards of power, speed, and self-sufficiency.

Topping the list

are exciting 386s from Compaq and GRiD, and updates of revered favorites from Toshiba, NEC. and Zenith. Rounding out the roster are offerings from Dolch, Sharp, Kaypro, HP. and Epson. The result is a startling range of choices for the buy-

er-with the tiny, economical Toshiba T1000 at one end of the spectrum, the techno-deluxe GRiD at the other, and, in the middle, innovations in memory capacity, storage, displays, and design.

With power now rivaling, and in some cases surpassing, that of a standard AT, the new portables could be all the computer you need. Beginning on page 93, our editors review the latest luggables, portables, and laptops, telling you which ones to snap up and which to avoid.

BLACK-AND-WHITE BONANZA Big monitors for desktop publishing are flooding the market, and black-and-whites are the most popular of all. CADD users have also iumped on the monochrome bandwagon, and now we're finding out that these large-screen monitors-with their hi-res crispness and clarity-are great for word processing, spreadsheet, and other general applications. The manufacturers know it too, and they're providing better drivers for Windows and the big-name apps as well as CADD and DTP programs.

In this issue, contributing editor Frank



PC Manazine contributing editor Frank Bican examines the most recent additions to the paper-white monitor market.

Bican rounds up the latest mono marvels and compares them with his last monitor review ("Screen Gems," PC Magazine, November 24, 1987) to see how far they've come. Bican's experience in production and typesetting, along with his everyday troubleshooting as PC coordinator of a large medical facility, makes him ideally suited to the task

Bican also wrote the story on WORM (write-once, read-mostly) optical disks, in which he concludes that maybe, just maybe, WORMs are ready for prime time. They're still expensive, and some are still glitch-ridden, but the best are worth looking at, especially for mass-storage capacity and backup applications. His report begins on page 199.

Productivity section home correspondence students should get your capes and cans ready for graduation as we present the fourth and final installment of our course in laser printer operation: creating custom graphics. We're also proud to introduce Douglas Boling, making his debut with a memory-resident calculator that's small in size and big on features.

ention. The followed to Guide in IBM Standard Personal Computing 1950 is F0008 3507; it published his weekly entrop in July and August for 1974 To insur-pre-172, in to incryption, and \$15 470 for these years. Additional prompts 11 Opps only you fit \$2.0 copy peer for Commissing distribution processing and the Section of Commission of Co



publishing power of the PostScript" page description language.

The new OMS JetScrint".

JetScript is the only Adobe PostScript controller upgrade authorized by HP and designed specifically for the LaserJet Series II. JetScript gives your printer the industrystandard page description language to accompany HP's PCL printer language. This expands your laser printing capabilities. Increases overall printer performance. Yet preserves HP functionality and warranties.

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Series II a form of expression that's found only with PostScript.

Simply, PostScript opens up the full range of possibilities for desktop publishing. You have complete control over the final look of the page, down to the last exacting detail. PostScript allows for an infinite number of font variations and sizes. That makes PostScript's limitless flexibility and power the perfect complement to your LaserJet Series II, giving you the highquality output you require.

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Planes, Trains, and Automobiles: 12 Portables for the Road

Nora Georgas/ Bigger disks, more memory, and faster processors give power to the portables. Compaq, Dolch, and GRiD offer machines that'll definitely put your desktoo system to shame: NEC. Toshiba, and Zenith make a good thing even better: Kaypro makes the leap to EGA; Epson, Sharp, and Hewlett-Packard round out the list, putting their best feet forward ... 93





FEATURES



MONITORS Black-and-White Monitors: DEVICES The Designer Collection

Frank Bican/ Bold new monitors with crisp displays are finding good homes with aficionados of desktop publishing and CADD software. Spreadsheet and word processing users are taking notice of all of the advantages they offer, too, We compare new offerings from Conographic, Comerstone, Micro Display, Monitern. NEC Home Electronics, and Princeton Graphic Systems to see how they stack up against our previous favorites from Sigma Designs, Taxan, Wyse, Thomson, and others 147

Your picture here: blackand-white monitors come clean for CADD, desktop publishing, and many other applications page 147.

MASS-STORAGE

The Worm Turns Frank Bican/ We've been keeping an eye on optical disks. and it looks as if they're finally here to stay. To help you choose, we put five of the newest WORMs through their paces to compare performance. The contenders are Information Storage's ISI 525 WC. Maximum Storage's APX-3000, Micro Design International's LaserBank 800, Symphony Systems' N/Hance 525 Optical Disk System, and the Optotech 5984 199

CONNECTIVITY Making Connections: Northern Telecom's Meridian LANStar PC Frank J. Derfler, Jr./ The Connectivity Labs tests the Meridian LANStar PC, a lowcost LAN that shines in big installations and offers a

gateway to ISDN, too 227 Cover Photograph: Roberto Brosan



"The Breakthru 286 performed fluulessly with every appli-cation we handed it, including copy-protected programs and nony resident solicities at crear

then Manes, PC Magazine Insiding 286 was the and of choice. PC BusineSoftwarenew (Rated #1) "... Breaktivu 286 is a good rather and a quality product backed

eter of the AutoCAD User's Group The PCSG Breakthru 286 achieved the best performance ults of the caching boards tested."

Ted Mercks, PC Tech Journal (Rated #1)

"The 12-MHz Breakthru 286-12 speedup board is the fa of those tested, but not the most exp horsepower basis, if could be called the charpest boost and

Mark Welch, Instituted (Rated #1)

Think You Need an A Make Your IBM PC Faster Than an AT in Just 5 Minutes!



REPRINTED FROM INFOWORLD, APRIL 27, 1987 Breakthru 286-8MHz-\$395 LIGHTNING™-FREE with Breakthru reakthru 286-12MHz-\$595 speedup hardware-\$89.95 purchased separately

We are excited about our three speedup products. You probably know about our Lightning disk access speedup software that was awarded PC Magazine's Best of 1986 award (see box). After the smashing success of Lightning, in late '86, we

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Steve Manes, PC Magazine

Best of 86 review Loads with the DOS - always ready as a background

program to accelerate disk access. You do nothing everything is automatic. Programs that frequently ac-

cess the disk (hard or flopov) are made instantly up

to 2 to 4 times faster. Uses a principle greatly enhanced

from mainframe technology called caching. Fully ex-

all our competition measures itself because we achieve universal compatibility with other software. Data is

never lost. Order LIGHTINING separately or pel it free with your Breakthru 286 board.

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ploits Above Board mer

"Lightning is almost mandatory...." -

literally the most advanced, fastest, most feature-rich board available. The runawa success it has enjoyed truly proved that assertion. Now we go ourselves one bet-ter with the Breakthru 286-12. This new board has the clock speed cranked up from 8 to 12 MHz for speeds up to 10.2 times faster than an IBM PC. It is 50% faster than an 8MHz IBM AT, and up to a whopping 1,000% faster than a regular PC

guaranteed the Breakthru 286 board to be

HERE'S WHY THESE TWO BOARDS ARE SO SPECIAL

more, unlike competing

First, they install so easily. A half-slot card means you don't even have to give up a full slot. What's

products it works in the Compaq Portable and most clones. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, they are advanced. The BREAKTHRU 286 replaces the CPU of the PC or XT with an 80286 microprocessor that is faster than the one found in the AT. Has a 80287 math coprocessor slot for numeric intensive applications. A 16K cache memory provides zero-wait-access to the most recently used code and data. Speed switching software allows you to

drop back to a lower speed on the fly for timing sensitive applications. Third, you have full compatibility. All ex-isting system RAM, hardware, and peripheral cards can be used without software modification. Our boards operate with LAN and mainframe communication products and conform to the Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Faster and smarter than an AT - PCSG

Fourth, these are the best. There are several other boards on the speedup market. We at PCSG have compared them all, but there simply is no comparison. Many cards offer only a marginal speedup in spite of their claims and others

are just poorly engineered. We are really excited about these products. PCSG makes the unabashed state ment that the BREAKTHRU 286 card represents more advanced technology than boards by Orchid, Quadram, Pi Technologies, Phoenix...we could

go on. Breakthru 286 is undisputedly the turbo board with the biggest bang for the buck. And we include FREE the \$89.95 acclaimed Lightning software. Call today with your credit card or COD instructions and we will ship your card the very next day.

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Everyone who tries it, tells us, "It's the best there is."

Don't take our word for it. Use Lucid 3-D for 60 days. Return it for a full refund if not completely satisfied. Plus, instead of the \$199 list price, an introductory spread-the-word price of \$99.

Lucid 3-D is priced to sell at \$199. but we want thousands of people using Lucid everyday, all over the world. We invite you to be a part of that group. The reason we are offering Lucid for only \$99, on a sixty day return for a full refund, is simple. Preliminary user testing of the product produces the same results over and over. People tell us they would never work without Lucid 3-D again. Even folks continuing to work with 1-2-3. Memory Resident

That's because the idea of a memory resident spreadsheet makes sense, one that you can pop-up instantly while working in your word

Advertising

fi for help or fill for sens

913: SHRKDE: 0153 12 94am Jan 1, 1988

way we dreamed a spreadsheet would function. Everyone who has seen it says things like, "Lucid 3-D is how software of the 1990's will look and perform" or even more to the point "This is the

MARKET I thought a computer should work" You'll see, Lucid is exciting.

way. Users say "It is so intuitive that I reallu don't need a manual." That's because we use something we call a visual command menu. Jim Seymour, the noted PC columnist, talking about Lucld in a recent article said that, "If there ever was an interface idea so good it ought to be stolen and widely used, this is it.

What he was talking about is a new menu approach that follows a simple design concept: it is easier to recog-



FIG. 1 Let's get the detail on those ad costs. Just move the widebar to that cell and press one key (grey +).

> nize than it is to remember. As choices are made on a menu that take you to lower levels you always can see

> exactly where you came from and

where you are going. The complete

menu path is always visible. You can-

What Makes it so Special In the

screen examples you can see Lucid

not get lost several levels down. This means you never have to remember a command, you just flow right to it. is really

FIG. 2 Here we are, instantly. Notice the lower left corner showing we are on level 2. You can go down or up. (See next page)

processor or any other program. Lucid lets you cut anything on the screen and paste it right into Lucid. or cut anything from a Lucid worksheet and paste into the application below. You can even run Lucid on top of 1-2-3 if you like, and cut and paste information from one to the other, including formulas.

Lucid 3-D was developed over the past two years with countless, exhaustive hours of planning and programming to produce something spectacular. This is a product that works the

multi-dimensional. Any cell of the spreadsheet can contain a complete other spreadsheet that you can access with a single keystroke. It is as simple as the pictures show. And you don't have to write formulas to do that. All you do is go look at the other file, navigating through easy, point and shoot directories. When you come back up (with one key) the link is made automatically for you.

Everything about Lucid works that

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Any cell can contain a complete other spreadsheet that you can access with a single key.

Plus, no matter where you are on a menu or what you are doing, just press function key F1. and you will get a help screen specific to that command or action. Or if you want to know about any subject you can pop up an index of over 400 topics and select the one you want.

Notepad Behind Every Celi

Another 3-D feature is that any cell can also contain a multiple page note that you instantly access with a single keystroke. You can write



FIG. 4. Now, instantly we are on level 3. Each level is a different spreadsheet. You could now move to the New York Times and see the detail on that figure. There is no limit to the levels you can go, Move right down to transaction level if you like.

notes, memos or letters that relate to your work, save them as individual files and even print them separately or with your spreadsheet.

Speed

Lucid 3-D is truly revolutionary. It is fast, fast, fast! It is incredibly quick in performing calculations because it doesn't recalculate every cell every time you insert an entry. Instead, it only recalculates the specific cells that are affected by your change. This is called minimal recalc. Lucid also has a remarkable innovation called background recalc in which you are given control of the cursor the moment calculations affecting your viewing screen are completed. Other calculations you don't see continue on in the background during the next commands. The end result of this powerful combination is you rarely wait for a recalculation with Lucid. You find out what instantaneous is all about. Lucid Learns

Lucid 3-D also lets you teach it any

combinations of keystrokes so that involved sequences can be.

volved sequences directories, differe can be. done with single keys. Plus more than just remembering keystrokes, Lucid allows you to create Macros with loops.

just remembering lesystroises. Lucid allows you to create Macros with loops, procedures and conditional branching amazingly all done automatically with simple menus. You can create your own menus that show the new features you have taught it. Another great feature is you can make your custom menus world like Lucid where one choice can take you can wake your cost on menus world like Lucid where one choice can take you down when it is not so that they will work from one spreadshest to a norther.

dereiting has 118 (or set of the set of the

The best idea I've seen for a spreadsheet in years.

Jim Seymour, Columnist. PC Magazine. PC Week



Fig. 5. Of course, Lucid does multiple windows. Notice, you can simultaneously open windows in different directories, different drives, even down as many as 3-D levels as you like. No one else cando that.

Mouseability

Lucid 3-D was designed for both explorant enhinsiants and mouse lovers alike. You can take your pick. Designed around the mouse from the ground up, the interface is smooth from directory lists. Everything is point and click. What's more any Lucid 3-D menu selection can be "moused" and the response time is "right now" instead of the stuggish "a little bit behind you." Fiel of add-on would be seen with 12-3.

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A window pope up with a library of function names you can page through with the mouse. Select. Click and 18's in the formula with no typing required. You even have a label window that you can fill from the keyboard; with favorite labels and names so that you can linear them later with the mouse. There's even a pop-up calculator to insert numbers so you do have to go to the keyboard very often. It really vermits that feeling of be.

It reasy permits that retening to becoming one with your work. Lock 30 years coming one with your work. Lock 30 years harmers as well as the macros named by the user that can be selected usit by pointing and clicking, icons that are easy to grad with the mouse let you resize and move the spreadsheet window with the easy you would enwindow with the easy you would entitly the proposition of the proposition of the the sheet by moving the mouse and clicking on the spreadsheet borders. And remember Lucid is designed so that any of those features are done with or without the mouse easily and quickly.

Audit

When you are staking a big decision on information gained from a spreadsheet you need to be certain that you have made no mistakes. Lucid offers five audit displays and printouts.

Masterwork

We could go on at great length about all the features and innovations in Lucid, but Lucid is more than a bag of features. What is most important is the pride and craftsmanship that went into its creation. It is a master

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Beginning or a primite fast the passion of the p

work. The overall feel is tight and polished. In fact, Paul Somerson, executive editor of PC Magazine. used one word to describe it, "Slick".

FIG. 7 Here It

is right in Word

Perfect (or any

word processor)

Just like you

You can go

the other way

just as easily.

typed it.

PCSG has built a reputation as a development laboratory producing products that you know are excellent In 1983 PCSG dominated the Model 100 laptop market with ROM based software that every reviewer rated as excellent. In 1985 we produced UGHTNING the pioneer and award winning Disk speed up software. In 1986 we developed the BREAKCHT# 265 accelerator board that blew everything else out of the water, and later we topped ourselves with the Breakthru 12. Now in 1987 those who have worked with Lucid 3-D tell us "wow have done it again. This is software everyone should have."

Even if you don't plan to abandon 1-2-3. Lucid makes sense. Files are converted between them with ease so there's not an interoffice compatibility problem. This means you can have the power and fun of Lucid 3-D without having to upset your present systems.

We are excited about Lucid 3.0. But on the don't take us us of ont take us us of the don't take us us of the don't take us us of the don't take us us or order line number and we will ship your order the very next day. This SPO offer won't last because we will be shipping to the dealers soon. But in the mean time we invite you to try Lucid as part of our "spread the news" campaign, lust pick up the phone and call us. We accept all major credit cards or you can order COD.

Exceptional spreadsheet for the IBM PC, PS and Compatibles.

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If you have Lotus 1-2-3 and \$199, you can now solve the six biggest spreadsheet problems:

Has your spreadsheet grown so complex you can't keep track of the formulas any more

Have you had to break down your arge spreadsheet into many smaller ones

3 Do you have to manually re-enter data that's duplicated in several spreadsheets'

Do you have to manually manipu late rows into meaningful groups?

5 is recalculation time for seldom-used reference variables eating Do you wish you could simul-

taneously share spreadsheet data with other PCs, as well as with minis and mainframes? Now, ORACLE for 1-2-3 turns your spreadsheet into the world-class database you already know how to use. And without learning a new database language, you can use the very same ORACLE that's the most requested DBMS by minicomputer and

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With simple extensions to exis Lotus menus, ORACLE for 1-2-3 lets you create new database tables right from rows and columns in your dsheet. When you query the database from a cell, you immediately see current database information. Update a spreadsheet cell, and the



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ORACLE FOR 1-2-3: THE NEW STANDARD

ORACLE is the number one data base for mainframes, minicomputers and workstations. Software Digest recently rated ORACLE the most powerful and versatile relat DBMS for the PC. And ORACLE is based on SQL, the data management standard endorsed by IBM, ANSI, ISO and the federal government, Now. there is a new standard: ORACLE

for 1-2-3. It has the simplicity you've always had, with the power you've always wanted THE ADVANTAGES OF

DATABASE TECHNOLOGY

Il your data is in a database, your

just the beginning. Multiple users can share the same data. Different users can have different levels of security. Mainframe-class

data integrity and error recovery mean never having to say "Ocops * CREATE YOUR DATABASE FROM SPREADSHEET COLUMNS AND ROWS Familiar menus and context-sensitive help guide you through the process . QUERY YOUR DATABASE AS

dramatically improved. But this is

. UPDATE YOUR DATABASE AS YOU UPDATE SPREADSHEET CELLS. In update mode, changes in your intradsheet become changes in your database. And if you make a mistake you can . COMMIT OR UNDO CHANGES. Finally, an "UNDO" command for

data management standard

1-2-3! When your database changes are complete, you can COMMIT them, or ROLLBACK your database and your spreadsheet

· AROUND YOUR OFFICE OR AROUND THE WORLD OR ACLE for 1-2-3 is network ready for data distribution on LANs and WANs. So data on PCs, workstations, minis and even on mainirames appears as if it's on your local hard disk

HEARD ENOUGH?

WE'LL PAY SALES TAX AND SHIPPING IF YOU FILL OUT AND MAIL THE ATTACHED COUPON OR CALL TODAY, YOU CAN ALSO EASY AS 1-2-3. Have the query built SEE A DEMONSTRATION AT YOUR lor you, or write SQL queries your-self. Learn why SQL is the industry FAVORITE COMPUTER STORE.

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LETTERS TO PC MAGAZINE



PLEASED WITH MAIL ORDER

Thank you for your very in-depth discussion regarding hard disk mail-order purchases ("The No-Sweat Way to Pump Up Your PC: Mail-Order Hard Disks," PC Magazine, December 8, 1987), It was slightly off on timing, as I ordered and received a hard disk drive through a mail-order firm just 2 weeks prior to your article. However, I was fortunate in selecting the Editor's Choice, Lifetime Memories, as a vendor, and in taking the steps so splendidly outlined in your article. Michael Lee

Alhambra, California

HARD DISK

On the strength of your article "The No-Sweat Way to Pump Up Your PC: Mail-Order Hard Disks," I ordered an ST225 drive and Western Digital controller

from PC Connection. Although the drive arrived within 30 hours of the time I placed the order, it did not work. PC Connection to the

rescue! They were friendly and seemed willing to spend as much time as necessary to solve the problem. They even shipped a new package to me by overnight air. So now that I am enjoying my new hard disk and controller, I

> Sam Gentry Earlysville, Virginia

want to thank you for your article. SPREADSHEET COMMENTS

John C. Dvorak has finally come up with an insightful viewpoint ("Spreadsheets? Just Say No!," PC Magazine, December 22, 1987). Indeed, spreadsheets, especial-

ly 1-2-3, are very messy programming languages and do tum users into boring accounting types. I'll have to watch myself when using spreadsheets, as my wife says becoming a boring accountant is grounds for divorce!

Saul Douglas Roe Monterey Park, California

John C. Dvorak is rightly known as a perspicacious commentator on PC issues. However, his editorial in the December 22 issue ("Spreadsheets? Just Say No!") was neither up to his own standards nor the standards of responsible journalism. His position-that dependence on spreadsheets is injurious to the human spirit, or style, or something-is certainly one a reasonable person might take, but his defense of it is essentially a prolonged whine. In fact, by the end of the article I was wondering whether I was reading an April Fools' Day issue by mistake.

Please encourage Mr. Dvorak to return to analysis of issues and to leave invective behind

Brian Rice Oberlin, Ohio

No, indeed, John C. Dvorak, your short essay on the mentally deleterious effects of spreadsheet use (or abuse) delighted me ("Spreadsheets? Just Say No!"). And no. you're not in trouble in this quarter for being overly radical. In fact, you're right on target in identifying a problem with spreadsheet users. But remember, the sloppy thought patterns used today by spreadsheet freaks are merely a challenge to all of us to tighten our thinking on higher levels.

> William Frangos Salt Lake City, Utah

CADD KUDOS December 8, 1987).

Many thanks for Joel N. Orr's excellent review of low-cost CADD programs ("Upwardly Mobile CADD," PC Magazine,

group of reviewers are to be commended for their perseverance in trying out so many programs. I know from personal experience with just four CADD pro-

Mr. Orr and his grams how hard it is to switch between

How about an article in a future issue reviewing high-end CADD packages, hope-

fully by Mr. Orr and associates? Kevin Talbot

Redmond, Washington PC Magazine is planning to do a high-end CADD blockbuster article sometime in the

summer of 1988.-Ed.

SOLOMON III IMPROVED In a past issue of PC Magazine, you re-

plied to a reader who was inquiring about your Editor's Choice comments regarding Solomon III's multiuser version (Letters to PC Magazine, November 24, 1987). In your reply, you suggested a user may have difficulty upgrading from single-user to multiuser Solomon III.

On behalf of TLB, I want to inform you that we have taken significant steps to improve the upgrade path for Solomon III users. While it is true that the upgrade process was difficult in previous versions, we have made this process relatively simple under the current version, 4.03a, as a direct result of user suggestions and input.

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■ LETTERS

Under Version 4.03a, users only need to purchase and install the multiuser System Manager without performing a database transfer or changing programs. All the application modules purchased, as well as all the data files entered under the single-user version, are immediately usable when up-

grading.

Mark E. Rossi

Marketing Communications Manager TLB Inc. Malvern, Pennsylvania

SOFTWARE PACKAGING

Jim Seymour packaged "Software Packaging" very neatly in the December 22,
1987, issue. His column should be obligatory reading for every publisher who
would like to sell more software. Howevre, he might have added one other item that
could be improved: informative packaging, which goes beyond well-designed
graphics or empty words like "new and
improved."

Some publishers think a pretty package is enough. They omit serious descriptions of their product's features anywhere on the exterior packaging and settle for empty space or a few endorsement blurbs. Information about product performance and capacity is essential to capture the interest of the software customers who browse among the \$30-to-\$200 packages. These customers are more likely to buy products that tell what they do, what hardware they require in order to do it, and what size tasks can be handled. Software packages that are silent about performance stay on the dealer's shelf waiting for the very susceptible indeed.

Robin F. C. Dempster Marshall, Virginia

Jim Seymout's column ("Software Packaging") expresses a view with which I strongly disagree. Far and away my favorite form of software manual is the threering binder, and I believe anyone who uses his manuals would agree.

Unlike the three-ring binders, the bookstyle manuals à la Bordand won't stay open when in use, can't easily be updated, and don't protect the disk. In addition, the spiral-bound manuals, now common for many printers, are easily damaged when opening and can't be identified from the

spine. I only wish I could get all my software with three-ring binders. And I'd gladly pay the cost difference.

John Pellet Arlington, Texas

Jim Seymour's "Software Packaging" column is all wet. He is not speaking for me. I very much like the boxed three-ring in binder packaging for software. They're free-standing on the desk, they look neat on the shelf, and most important, I can insert my own pages of updates and notes from Power User, Spreadsheet Clinic, and 6-so forth, into them.

It must have been a slow news day for Mr. Seymour. Maybe it was too chilly to go outside?

> Norman Peterson Santa Monica, California

ENABLE ENLIGHTENED

Your recent article "Making Connections: Integrated Multifunction Programs for LANS" (PC Magazine, November 24, 1987) contained an extraordinary amount of erroneous information concerning Enable's functionality.

In fact, it required a 12-page letter to your publisher and editor-in-chief, Bill Machrone, to cover only our principal concerns in an attempt to set the re-



cord straight.

Now, I'm writing this brief letter on behalf of some 200,000 current Enable users who already know better and all future Enable users who deserve to be more accurately informed.

We at The Software Group acknowledge the importance and influential pervasiveness of PC Magazine to our industry. The authors of this recent article departed from your well-known guidelines for objectivity and accuracy—a situation that, we hope, you will want to redress fully.

Il want to redress fully. Theodore F. Newlin III President and CEO

The Software Group Ballston Lake, New York

As a longtime subscriber and advocate of PC Magazine, I have always been im-



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■ LETTERS

pressed with the accuracy and fairness of your reviews. My respect has slipped a notch or two after reading the comparison of integrated programs for LANs in which major errors were created by totally inaccurate statements about Enable ("Making Connections: Integrated Multifunction

Programs for LANs".).
When we compared Open Access II,
Smart, and Enable before choosing our
LAN application software, we found several major problems that your authors
didn't seem to find. For example, the
Smart system has a major limitation that
instantly removed it from consideration as
a multiuser LAN database—in Smart
LAN, if there is just one index filed in a database, then only one user can have access
to that database. This important informa-

tion was not even hinted at in the article. Also, the reasoning behind the comments in the Editor's Choice box defies all known LAN logic. The biggest single reason for buying a LAN with LAN-type application is shared database access. Yet in the Editor's Choice box, the author admits in Marrie "week point is the database." Give me a break. Perhaps in the next perhaps in the next will pick the spreadsheet comparison, PC Magazine will pick the spreadsheet comment face but the weeker number-crunching face but the weakers number-crunching.

ability.

I've never written a criticism of a PC

Magazine review until today. However,

 The reasoning behind the comments in the Editor's Choice box defies

all known LAN logic.

when your writers blow it, they do it big time. 1 expected better of PC Magazine

Kevin Shaw Austin, Texas

FANTASTIC

and I am disappointed.

Mark Novisoff and Ray Duncan are both fantastic! I can hardly wait to read Duncan's future articles about MASM and swer letters personally.

QuickC. And please have Mr. Novisoff write more about QuickBASIC 4; his article on programming libraries was great (PC Lab Notes, PC Magazine, December 8, 1987).

Randy D. Peck Bell, California

DÉJÀVU

In the December 8, 1987, review of Dipidi (First Looks, page 48), Denald B. Trette states, "When you have the only product that allows the most popular spreadsheet program to talk directly to the most poputar talkness the most popular spreadsheet program to talk directly to the most poputar database program, you don't vove to much about speed." This comment, though perhaps twee in essence, is much 1872 and that DBIZIII. a Lous 1-23 add in from Triple C Software, also allows 1-2-3 to talk to dBASEII.

> Edward H. Claggett President, Triple C. Software Fort Lauderdale, Florida

CORRECTIONS/AMPLIFICATIONS

tion

Complete Computer Services' CCS Designer ("Upwardly Mobile CADD," PC Magazine, December 8, 1987) does boldface text, snaps to the center of a circle, displays cursor coordinates, displays object dimensions, measures distance point-to-point, and mirrors symbols on inser-

The correct phone number for CDE Software, maker of the program Checks & Balances (After Hours, PC Magazine, January 12, 1988), is (213) 661-2031.

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What Does The Clipper Compiler Do? Clipper TM compiles dBase III TM and dBase III PlusTM source code programs. procedure and format files into a binary program which can be distributed and

executed independent of dBASE How Much Faster Is Clipper?

Applications run up to 20 times faster than the same application in dBase III or dBase III Plus. The average application typically runs 5 or 10 times faster.

ow Compatible Is Clipper With Base III and dBase III Plus?

Clipper supports the majority of dBase III commands except those that are normally used interactively. There are some minor differences in the implementation of some other commands.

DBF, FRM, MEM and LBL files are the same as interpretive dBase III. Clipper index files have the extension .NTX (corresponding to dBase .NDX) and result in faster indexing and more efficient use of disk space.

NEW VERSION: CLIPPER SUMMER '87

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- interactive command simulation (BROWSE)

Does Clipper Support Networking? Yes. Both versions Autumn '86 and Sum mer '87 allow you to run compiled applications on most popular networks. They feature record and file locking and support Expanded Memory

A second work station may view or read a locked record or file and produce reports. However, an operator of the second station cannot update or write to a locked record or file

Do I Need Any Kind of Runtime Me To Run A Clipper Compiled Program? No. Clipper produces an object code module with the extension OBJ. When the

OBJ file is linked (using PLINK86 which is included) a relocatable file with the extension .EXE is produced which can be run directly from DOS.

Do I Need Clipper For Every Program I Distribute?

No. You can compile and distribute as many programs as many times as you wish. Nantucket charges no runtime or royalty fees for distribution of your comniled applications.

Are There Royalties For Adding Work Stations?

No. Clipper places no limits on workstations. You may add as many work stations as your networking software will allow with no additional fees

es Clipper Handle Memo Fields? Yes. Memo fields can be stored as string values, allowing them to be searched, concatenated and REPLACEd, ASCII text files can be read into memofields and memofields can be read into ASCII text files.

Compiled EXE Files?

The minimum size Clipper file is about 145K. This overhead is a one time expense and is present in even the small program. DOS requires 30-40K of memory. In addition, Clipper requires 64K for its own purposes once loaded, which means that in a 256K machine you could load a program of about 160K into RAM. If you create a program that exceeds your computer's memory, you may create overlays to work around the problem.

What Are Overlays? Overlays are portions of your application

that will NOT reside in your computer's memory until executed. An area of memory is designated for overlays by the linker. You then specify which portions of your program are transferred in and out of that memory area

In What Language Is Clipper Written? Clipper is written in the Microsoft C (5.0) language with some assembly language

es Clipper Allow You To Create Windows?

routines

Yes. With Clipper's new SAVE SCREEN



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They use the ClapperTM compiler to combine dBASE with C and assembler With dBASE used like pseudo-code. they can then quickly create prototypes that actually run

Then, with dBASE doing the high-level database functions, they use the Clipper compiler to link in C or assembly last guage modules from their own bag of

And they're finding that they're linking in less than they expected because Clip per compiled code runs so fast and be cause of Clipper's built-in enhancements Clipper includes

· Easy networking that provides file and record locking the way it should be

 Fast screens that can be treated as memory variables and eliminate the need for direct screen writes and all that torturous heap management code . Box commands that made windowing a

breeze And more So if you'd like to use your time more productively, check Clipper out.

and RESTORE SCREEN commands windows can be created and manipulated.

Will Clipper Interface With Microsof WindowsTM? Clipper will run and compile with Micro-

soft WindowsTM but will not run as a senarate task Is Clipper Limited To 640K Of RAM?

No. Clipper employs the Lotus/Intel/ MicrosoftTM expanded memory protocol allowing use of up to 1 megabyte of RAM.

What Hardware is Required To Run Chipper? Clipper rurs on any IBM PC, XT, AT, 3270 or 100% compatible machine running DOS 2.0 or greater for single user applications. Networking applications run on most major networks supporting DOS 3.1 or higher

Is Clipper Copy Protected?
No. Copy protection was removed with
the release of the Autumn '86 version

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genrous demo call for a C-Worthy with Forms Library BASTOC BASIC Into C

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Code generator for dBASE The UI Programmer was developed for professional dBASE programmers who have been frustrated in the past by code rators. Up until now, a sersous dBASE programmer had to take what

ever code a generator produced and modify it to their needs. With UE, the developer can generate exactly the dBASE code wanted Ul (User Interface) has two main func-Ul (User Efferment) mass you make the house the first as a powerful forms edinor to crease sophisticated screen and menu forms in a marker of minutes. The editor is completely menu-driven. It works on the "point-and-shoot" principle—sizt put the cursor where you want and tell UI what to put there Ul's other, more important, main function is generating code for the forms

you've designed. Once you have a form the way you want it, you call up the "Generate" menu, and tell UI which template you want to generate the code with That's the key—each semplate tells UI to produce a different kind of dBASE program

It's through these terms can program the way UI generates source code You can use the templar that come with UI 'as is 'there are about 25 of them), completely rewrite them, or write your own. So you don't lose control of design. like you do with other generators. You just let UI do the

DOCUMENTOR DATA-p

dbase at the speed of C dBx Translates dBASE Applications to C

You dBASETM programmers know what an expressive and readable language dBASE is it's a very combinable devel-opment environment. But the price is de based performance. Even compiled. dBASE doesn't offer the speed that some users require these days. The kind of users require trees cays. The Autority speed offered by software written in the Clanguage. The asswer is dBxTM.
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way to complete in the use day to translate them top to bottom to C¹ Other advantages C is portable, even to other operating systems like UNIX/ Xeso(TM, To the Macinical or Amaga dBx gives your applications a passport to places dBASE cannot go. Has as own file manager for single user, but links to major C file managers—

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Many worthy unlay products supply needs that dBASE* is programming lan-guage doesn?—dUTILPM dFLOWTM and a host of others. Trouble is, you have



their output into your dBASE program No longer dBRIEFTM, written in

and turns # into a complete dBASE III and III Plus programming domain Using BRIEF's underlying shell capable-ties and its own interfaces, dBRIEF can ties and its own instruction, other can run external utility libraries, plus dBASE itself, and link to the CapperTM. Foxbase + TM and Quicksiver completes all with dBRIEF still loaded and running the show it can do what BRIEF already does note:

. Convert a screen layout into dBASE ode for interactive data entry

• Display dBASE file structures in

 Expand keystrokes into full dBASE. Indent automatically for clegic

 Create databases, index files, invoke Ashton Tate's dFORMATTM and dCONVERTTM, draw lines and boxes "Surply marvelous programming en-vironment for writing and editing dBASE programs", PC Megazine, 1/86 Source

code includes curren BRIEF 132 or later and 394k. Si2k to run dBASE within dBRIEF, 640k

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OVERDRIVE Take the Doze out of DOS drive will run even faster on your RAM

If you are one of the millions of personal if you are one of the missions of peterons computer users who are finastrated by slow disk access, you need OVER-DRIVE Overdrive will make your disk-limited programs such as databases run faster How fast? It depends upon your particular circumstances, but SOW speed

increases are not uncommon

For example, a dBase III accounting program ran 50% famor and a large Condor 3 database whose SORT time was 80 metates, ran the same sort under Overdrive is not a disk cashe, an op-temper or a RAM disk. In fact, Over-

DOS "thinking time", not the disk time Overdrive hooks steel into DOS and replaces its old slow program code with modern, efficient, well-designed

Overdrive adds handy directory usin-ties and improves the speed of DOS backup and copy functions remarkably Runs transparently and takes up only 2KB of RAM for itself plus around 1/2KB per Megabyte of hard disk capacity

dBC Identical dBASE III Plus Files Using C

d BCTM is a series of C libraries from Lattice which creates, accesses and updates files identical to those of dBASE itself. So dBASE can read and update the

hat for? It means both C and dBASE applications can operate on the same data bases interchangably it means C programmers can interface with the big programmers can mension with the big market of dBASE users out there, yet side step the dBASE language. It means dBASE applications can now be linked to the universe of C libraries and tools to add windows, graphics, statistical analy-iss, all the things dBASE cannot do B means the speed and power of C to un-press clients accustomed to dBASE of dBC's functions p. Bel all dBASE's file to permit direct data manipulation. Ten to permit digge data manaparation for each of data, index, and memo files may be open at once it is so complete an ISAM package that you can forget dBASE and use dBC only for C programming Our versions of dBC missic file formats for dBASE II and III and now dBASE III

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CIRCLE 310 ON READER SERVICE CARD

PC ADVISOR



Help in getting control over the PC's cursor, in choosing a personal stock and bond portfolio package, and in putting together an image database system.

STOP THAT CURSOR!

Dripping faucets, flickering lights, and blinking cursors have the same effect on me—absolute irritation. I can fix the faucets and lights quite nicely, but the fix for the blinking cursor cludes me time and time again. What about it? Also, how can I speed up the cursor?

John C. Ausland Oslo, Norway

NoBlink/Accelerator, a 549.95 package by Nostradamss Inc. (Salt Lake City. Utah; (801) 487-9652), should rid you of your final irrilant. NoBlink replaces your cursor with a solid block; the character behind the cursor shows up in reverse video on monochrome systems or in another color on color systems. If you use an EGA, you can 'choose the block and character colors on the fly.

As its name implies, NoBlink/Accelerator also includes routines to speed your cursor and stop cursor run-on. You can also blank your screen (to prevent burn damage) with the touch of a key. I prefer this approach to the automatic, time-activated screen blankers found in some utilities.

NoBlink operates as a memory-resident program, but it rates extremely friendly as TSRs go and occupies only 6K RAM.

If you decide you want even more control over cursor speed once you've tried NoBlink, try to get your hands on a copy of KBFIX2 (Skip Gilbrech, 90 Lexington Ave., #10-G, New York, NY 10016), a public-domain program that gets along well with NoBlink. All you have to do is dial up your favorite bulletin board or contact a user group to locate a copy. In addition to controlling cursor speed, Version 3.0 allows a few nice keyboard tweaks if you choose to use them. Best of all, KBFIX2 costs nothing.

Alternatively, you may want to dish out \$39.95 for Cruise Control from Revolution Software Inc. (Randolph, N.J.; (201) 366-445), a commercial speed enhancer for your cursor.

PC VIDEO

As a security consultant, I have a number of clients who could benefit from a computer-based photo ID system for personnel and other uses. I already own a video camera, a VCR, and an IBM FC AT. Most of my clients own several XTs or ATs. What equipment do we need in order to start photo ID systems?

Gary Huntington Houston, Texas

NoBlink operates as a memory-resident program, but it rates extremely friendly as TSRs go and occupies only 6K RAM.

You'll need an image capture board to link your camera or VCR to your PC. You'll also need a picture database software package to get a system up and running. In simple terms, an image capture

In simple terms, an image capture board lets you display single-frame video images or continuous real-time images on a monitor. A camera or VCR feeds the real-time images to the image capture board. When you see an image you want to store for editing or later viewing, you command the capture board to freeze the image and then store it in digital form on your

The picture database software packages way greatly in the features they offer, but all give you some way to store images as one or more fields of a database record. They should also supply the interface to the specific image capture boards they sup-

The PicturePower Color System-PicturePower software coupled with Truevision Inc.'s Targa 16 board-earned our Editor's Choice over other picture database systems in our recent roundup ("Picture Databases: Coming into Focus," PC Magazine, August 1987). The Targa 16 board produces clear, colorful images, and PicturePower makes setting up an application easy for anyone comfortable with using a PC. However, the total systemincluding the Targa 16, RGB analog monitor, and RGB color camera-retails at a whopping \$6,230. But if you already own a composite or RGB analog monitor and camera, you can set away with spending \$2,995 for the Tarea 16 and \$945 for PicturePower

PC ADVISOR

For a more economical color system, you may want to opt for the ATronics International Professional Image Board (PIB)-an image capture board similar to the Targa 16 that costs only \$799 (Milpitas, Calif.; (408) 942-3344). The Picture-Power programmers plan to have compatibility with the PIB built in by the time this issue hits the stands.

The PicturePower Grey-Level System. essentially a black-and-white version of the Color System, retails for a more wallet-pleasing \$3,200-including the Chorus Data Systems PC-Eve image board, black-and-white monitor, and black-and-white composite camera.

PORTFOLIOS, PC STYLE

I am currently using Personal Financier on a Compaq Deskpro. I am considering changing my home finance program to another, primarily because Personal Financier does not provide even a semblence of

a stock and bond portfolio manager. Please recommend a program?

Philip Shaw Winnipeg, Manitoba Canada

Since it sounds as if you and Personal Financier get along well on most counts, your best bet may be Sylvia Porter's Personal Investment Manager (\$149.95; Timeworks Inc., Deerfield, Ill.: (312) 948-9200). This powerful standalone package generates numerous reports and graphs to track the performance of your stocks and includes many time-saving features, such as its ability to shift investments automatically from short- to long-term status at the appropriate time. It also provides for automatic quote updates from the Dow Jones News/Retrieval service.

If you'd rather leave Personal Financier behind and make the change to a complete, integrated home finance program, go with Andrew Tobias' Managing Your Money (\$219.95; Micro Education Corp. of America, Westport, Conn.; (203) 222-9150). Managing Your Money, long the market leader, has been criticized for its copy protection (you have to insert a key disk at the program's request now and then). But Version 3.0, with its contextsensitive help and new 200-page manual, gives users lots to cheer about, too.

Managing Your Money has powerful

options for monitoring the performance of

your stock. It also gives you integrated checkbook and budgeting functions. Unfortunately, you'll have to cough up an additional \$79.97 for Andrew Tobias' Managing the Market if you want to update quotes automatically via Dow Jones. ASK THE ADVISOR

Send your questions to PC Advisor, PC Magazine, One Park Avenue, New York, NY 10016.





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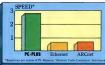
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FIRST LOOKS

IBM's 8514/A Graphics: Sharper, Faster than VGA

HANDS ON

BY CHARLES PETZOLD

IBM Corp. seems to think that
its 8514 video system is only for
specialized applications such as
CAD. That's why it gave the
system a number rather than a
name and put a 53,110 price tag

But the importance of graphics to the future of PC software indicates a much wider need for a high-resolution color video board such as the 8514A. The VGA included on the PS/2 system boards offers only marginal improvements over the EGA. The 8514A is a much more significant set forward.



PC Labs Dishered Cube display attempts to the out as many colors as possible from a probles system. On the IBM 8514/A it hardly broke a sweat.

The combination of the Display Adapter 8514/A, 8514 Memory Expansion Kit, and Color Display 8514 delivers a graphics resolution of 1,024 (horizontal) by 768 (vertical), with 256 simultaneous colors from a palette of 262,144 colors. By comparison, the highest graphics resolution of the VGA is 640 by 480 with 16 simultaneous colors (see table). The only VGA video mode that displays 256 simultaneous colors has a resolution of 320 by 200, which is inadequately low for most applications.

With 2½ times as many pixels and double the number of color planes as the highest-reso-

HP's 20-MHz 386 — a Hefty 60 Pounds with Room for Expansion

HANDS ON

BY JOHN DICKINSON
If you're conserved about the
durability of today's lightweight computers—like the
PS/2 models IBM is purveying—don't be. It turns out that
some vendors—and I don't
mean just Compan—are still in
the business of building beely
boxes stuffed full of computing
power. In particular, HewlettPackard Co's new line of floorstanding, 80386-powered Vectra RS computers are about as

trucklike as a computer can get and still be called a PC. The HP Vectra RS/20 Model 100 that recently arrived at PC

100 that recently arrived at PC Labs stands 25 inches tail by 9 inches wide, not including its 13-inch-wide footstand. The big PC weighs in at a hefty 60 pounds, attributable mostly to the galvanized steel shell that sits inside the RS/20's plastic case and surrounds the machine's guts—it serves as an RF shield as well as a beav-duty

shield as well as a heavy-duty structural frame. Perhaps more interesting than that, its 20-MHz clock

speed yields 80386 performance that falls just short of the PS'2 Model 80-111. That also means, of course, that the hig HP's performance falls short of the 20-MHz processing standard set by Compay's Deskpro 385/20. But is 9-millisecond access time, 103MB ESDI-controlled disk matches the performance of Compaq's 70MB disk, which means it handily beats IBM's 110MB ESDI disk made for the Model 80-111.

On a price/performance basis, the Hewlett-Packard comes (continues on page 36) HANDS-ON INDEX

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C-SCAPE

IBM's PostScript Laser Printer Generates Graphics Pages and Headaches Quickly

HANDS ON

BY MITT JONES IBM Corp. gave the PostScript

page description language a big push last April when it announced that its own laser printer, the 4216 Personal Pageprinter, would have its own PostScript adapter. But it's taken IBM 10 months to deliver the system in any kind of volume. As soon as the machine arrived here several weeks ago, testing began in PC Labs, with an Apple LaserWriter Plus sitting in for comparison.

Based on the Ricoh engine, the Pageprinter is much smaller and lighter than the LaserWriter Plus But the differences between the two extend beyond their appearances.

Like the LaserWriter Plus. the Pageorinter enlists a Motorola 68000 processor to translate PostScript images into the bitmapped images the machine actually prints. But IBM departed drastically from the design of the LaserWriter Plus by placing the 68000 and the printer's 2.5MB of memory on an adapter board-the Personal Pageprinter Adapter/A.

This approach carries one obvious liability—the adapter fills one of your slots. But it also improves print speed by boosting the data transfer rate. Whereas the LaserWriter Plus attaches to a serial port and receives files at a maximum of 19.200 bits per second, the Pageprinter Adapter receives files for processing through the system bus and transfers the bitmapped images to the printer at an impressive average of 1.8 megabits per second.

Another departure from the LaserWriter design: instead of burning the interpreter into ROM, IBM elected to have Adobe's PostScript interpreter self-load into 512K of the adapter memory each time you boot up. On the down side, this means your system stands unus-

able for about 2 minutes after boot-up while it loads the interpreter and tends to other Pageprinter-related chores. On the up side, you'll be able to up-

grade PostScript versions easily and cheaply in the future. So far, so good. But IBM designers were

asleep at their drawing boards type styles, reside on hard disk. Apple LaserWriter Plus

when it came to deciding how to implement the many PostScript fonts. Instead of shipping the printer with all its font outlines burned into ROM, as did Apple with the LaserWriter Plus, IBM includes only 13 fonts in ROM. Its remaining 29 font outlines. which add variations of nine

Before you can use any of the 29 additional fonts, you must run a utility that IBM provides as part of the Personal Pageprinter Adapter Software. The utility, which runs under Microsoft Windows but can be accessed with a little trouble through DOS, loads the fonts you choose into the Pageprinter Adapter's memory. You can maintain as many as 18 fonts in

IBM partially makes up for

memory at any time.

this aggravation by allowing you to store and reload font caches. Most PostScript printers store recently used fonts-generated from the stored font outlines-in a font cache in the printer's memory to save the time of reconstructing the characters. But powering off the system flushes the cache, so the fonts have to be generated again before they can be used IBM provides a utility that lets you save a font cache as either an automatically loaded default or as a cache you can reload at will. This feature won't save a

some frustration. In yet another departure from traditional wisdom, IBM designated the printer output port as EPT in order to use a high-speed packet data transfer protocol. While this sounds good in theory, it creates some awkward problems in practice if you're not using a software package that specifically sup-

great deal of time, but if intelli-

gently used, it may save you

ports the Pageprinter. For instance, if you try to print a PostScript file from DOS without using the special printer utility IBM provides, you get a printout of the PostScript code. not the output the code is meant to generate. Similarly, if the program you're using doesn't support the EPT port, you'll get PostScript code for output unless you use still another IBM utility that maps EPT to LPT1.

Annoying irregularities aside, the Pageprinter, Page-(continues on page 35)



Our constitution is in actual operation; everything appears to promise that it will last: Courier Bold Underlined Palatino Bold Underlined Italia ZapfChancery Bold Underlined Italic Helvetica Bold Underlined Itali

Script standard and challenges the PostScript king, the LaserWriter Plus (above). **IBM Personal Pageprinter**



Our constitution is in actual operation; everything appears to promise that it will last; Courier Bold Underlined Palatino Bold Underlined Italia ZapfChancery Bold Underlined Italic Helvetica Bold Underlined Itali

Type: Laser (PostScript) Downloadable fonts: Avante Garde-Dem/Oblique Dem. ax. paper width: 8.5 in Price: \$4,999 (includes adapter and software) SPEED (ppm):

Default ASCII-54

TYPE PITCHES: Variable SOUND LEVEL (decibels):

Rated: 42-52 FEATURES: Resident fonts

Times Roman-Regular, italic, bold. bold state Helvetica-Regular, oblique, bold,

bold oblique Couner-Regular, oblique, bold, bold oblique Symbol-Regular

Bookman-Demitato, Demi Lighttalic, Light, Demittalic Garamond-BoldItalic, Bold. Lightitalic, Light New Century Schoolboo

Bolditalic, Bold, Italic, Rom. Palatno-Bolditalic, Bold, Italic, Zapf Chancery-Mediumitalic Helvetica-Black, BlackOblique,

BookOblique, Book

LightOblique, Light Konnna-Bold, KursryBold, KursrvRegular, Regular Zapf Diripbats

COMPATIBILITY: IBM character set: Low and high Graphics: PostScrpt, IBM Proprinter XL Text: PostScnot, IBM Proprinter XL. ASCII

IBM Pageprinter (continued from page 34)

printer Adapter, and Pageprinter Adapter Software make a fairly good team. And in contrast to the LaserWriter Plus running on a PC, the Pageprinter system returns error

codes at least occasionally. If you've ever tried to print a lengthy PostScript file, which can take as long as 30 minutes for an extremely complex page, you'll also appreciate the Pageprinter's speed for graphics-extensive applications. Running the Pageprinter and the Laser-(continues on page 36)

IRM 8514/A

(continued from page 33) lution VGA graphics mode, the 8514 might cause speed degradations in graphics programs if it implemented only a normal memory-mapped video display buffer. However, the 8514 also contains specialized hardware to perform many high-level graphics functions, including the drawing of lines, filled areas, text, and bit block transfers (bitblts). Application programs or 8514 drivers can take advantage of this hardware to achieve graphics display speeds that are much better than those associat-

ed with the EGA or VGA The 8514/A display adapter is built on two boards that snap together and fit in a special slot in the PS/2 Models 50, 60, or 80. This special slot has additional connectors that route video signals from the system board VGA to the 8514/A. Thus, the 8514/A can add to the capabilities of the VGA without duplicating its functions. (An 8514/A for the older PC bus is not available.)

The 8514 Memory Expansion Kit contains memory chips that go into the 8514/A board. Without these additional memory chips, the 8514/A is limited to 16 simultaneous colors.

Although you can use ar PS/2 monitor with the 8514/A adapter, you're limited to a 640 by 480 resolution unless you use the 8514 color display. IBM claims the 8514 display is 16 inches diagonally, but it's been using a fisherman's ruler for measuring PS/2 displays. The visible area of the tube is only 14 inches. This is not a large monitor such as those commonly associated with engineering or desktop publishing workstations. It has a disappointing low-contrast washed-out look indicative of the PS/2 color displays.

The total cost of an 8514 system (adapter, memory expansion kit, and monitor) is \$3,110. This may seem high, but it is much lower than comparable systems that offer 256 colors at this resolution (see "Four-Figure Video." PC Magazine.

May 26, 1987).

PC Labs tested the 8514 video system with early versions of 8514 drivers developed by Microsoft for Windows, Version 2.0. On a Model 60, Windows drew graphics over the full screen of the 8514 at rates ranging from 11/2 to 10 times as fast (depending on the drawing operation) than it does over the full screen of the VGA. Thus, the hardware assistance built into the 8514/A more than compensates for the greater resolution and color.

Although IBM's Professional Graphics Controller (PGC) included hardware-assisted graphics drawing, the PGC was geared toward the type of threedimensional drawing associated with CAD applications. The hardware drawing operations of



Display Adapter 8514/A IBM Corp Consult your local authorized IBM dealer.

List Price: \$1,290 Requires: PS/2 Model 50, 60.

or 80. In Short: The Display Adapter 8514/A is IBM's high-end video board for the PS/2 series. In the maximum configuration, the resolution is 1,024 by 768 with 256 simultaneous colors. The board includes high-level drawing finetum

CIRCLE 426 ON READER SERVICE CARC 8514 Memory Expansion Kit IBM Corp.

List Price: \$270 Requires: Display Adapter 8514/A.

on the 8514/A are quite similar

to those of the OS/2 graphics

programming interface (GPI).

which is the graphics part of the

OS/2 Presentation Manager.

This suggests that a Presenta-

tion Manager driver for the

In Short: These 16 memory chips plug into an 8514/A to give you 256 simultaneous colors rather than 16.

Color Display 8514 IBM Corn. List Price: \$1,550

Requires: PS/2 Model 30, 50, 60, or 80 In Short: The 8514 display is the only PS/2 monitor canable of 1,024 by 768 resolution. It can be attached to any PS/2 computer, but at really only makes sense with an 8514/A. Like all of IBM's color monitors for the PS/2 series, the contrast and screen size are disappointing CHICK E 450 ON DEADED SERVICE CAD

the 8514/A are more main-8514/A might achieve a high stream and are suitable for level of efficiency and that the graphics windowing systems 8514 may be an ideal video such as Windows and the OS/2 board for use with OS/2. Presentation Manager. In fact, IBM also makes available the structure and protocols of virtual device interface (VDI) the drawing functions available drivers for use with the 8514.

> technical reference documentation, and an application developer's tutorial package. When applications start to

take advantage of this combination, many heads will start to turn

IBM Graphics Standards: From CGA to the Display Adapter 8514/A

IBM video adapter	Introduced	Maximum graphies resolution	Simultaneous colors
Color Graphics Adapter (CGA)	1981	640 by 200	2 out of 16
Enhanced Graphics Adapter (EGA)	1984	640 by 350	16 out of 64
Professional Graphics Controller (PGC)	19B4	640 by 480	256 out of 4,09
Multi-Color Graphics Adapter (MCGA)	1987	640 by 480	2 out ol 256K
Video Graphics Array (VGA)	19B7	640 by 480	16 out of 256K
Display Adapter 8514/A	1987	1,024 by 768	256 out of 256k

IBM Pageprinter

Writer Plus side by side on a Model 80, we found the Pageprinter to be slightly faster printing PostScript text but significantly faster when handling large amounts of graphics.

For instance, our Bylines newsletter—used as a test publication for PC Magazine desktop publishing comparisons—print-

ed from PageMaker in about 6½ minutes on the Pageprinter but required slightly more than 8 minutes on the LaserWriter Plus. The graphs and scanned

Plus. The graphs and scanned image in the test publication required a large amount of data transfer, allowing the Pageprinter to take advantage of its high data transfer rate.

But eliminating all graphs and images closed the gap. The trimmed-down file required

about 4 minutes and 22 seconds on the Pageprinter and only 4 minutes and 44 seconds on the LaserWriter Plus.

All in all, the Personal Pageprinter performs well and ships for a reasonable 54,999, including the adapter and software. But be prepared for some aggravation. You'll need to learn the utilities if you want to live peacefully with the printer. And having to load fonts from disk before printing rates as a major irritation and a shining example of thoughtless design. List Pricer IBM 4216 Personal Pageprinter, 25, 199. Personal Pageprinter Adapter A. 51, 950; Personal Pageprinter Adapter Software, \$850. IBM Corp., Old Orchard Rd., Armonk, NY 10504; (800) 447-4700 (for dealer locations)

CIRCLE 454 ON READER SERVICE CARD

HP Vectra RS/20 (continued from page 33)

out pretty well, especially if you're looking for a file server with good disk performance. An RS/20 equipped with a 103MB hard disk, ZMB RAM, and HP's EGA display and adapter comes in at \$10,335, which is about \$3,000 less than an equivalent PS/2 Model 80 from IBM.

HP's cleverly designed system board probably looks like nothing you've seen before. A small (6 by 18 inches) planar sits at the bottom of the RS/20's huse cabinet and contains the 80386 processor and its 80387 coprocessing companion. Wytek's 1167 coprocessor is an option. This same planar comes with a standard equipage of 2MB RAM in the form of 70nanosecond DRAM mounted on interleaved 255K SIMM modules. By using optional IMB SIMMs, the system can be

configured to include up to 16MB RAM.

Unfortunately, the RS/20's otherwise clever system board does not include a static memory cache. That design decision explains the difference in CPU performance between the Pl machine and its competition from Compaq and the Flex-Cache 20386 from ALR. It does not, however, explain why the RS/20 is a tad slower than IBM's Model 80-111.

The system board is attached at a 90-degree angle to an AT-compatible I/O board that includes six 16-bit slots and four 8-bit slots, and gwin Acustom slot designed for the keyboard and mouse ports. The board, which can be run at an AT-standard 8 MHz or at 10 MHz, also includes two custom 32-bit slots for memory expansion beyond the 16MB you can pur on the system board. The company

does not currently offer memory

boards to fit in these slots.

The RS/20 can hold up to six half-height 51/4-inch devices, and it comes equipped with a 1.2MB floppy disk drive and, depending on which model you select, a Hewlett-Packard-built

select, a Hewlett-Packard-built 40MB, 103MB, 155MB, or 310MB hard disk. Up to two hard disks can be supported by the disk controller. That means you can equip the RS/20 with up to 620MB of excellently performing hard disks that, when combined with the heavy-duty design of the whole system, make the RS/20 an ideal file

server for a local area network. There is what looks like (in electronic component terms) acres of space on the 1/0 board for expansion. There's enough real estate on a blank RS/20 1/0 board to build a Micro Channel architecture-compatible bus, and—who knows—it's even possible that such a bus could be built to coexist on the same board with the standard PC.

style bus.



Palo Alto, CA 94304 (415) 857-1501 List Price: Model 40 (1MB RAM, 40MB hard disk), 57,495: Model 100 (2MB RAM, 103MB hard disk), 58,995: Model 150 (2MB RAM, 155MB hard disk), 59,995: Model 300 (2MB RAM, 310MB hard disk), 511,1995

RAM, 310MB hard disk), \$11,995. In Short: An oversized 20-MHz 386-based PC with good performance at a good price and lots of room for expansion.



Benchmark Tests: HP Vectra RS/20 vs. IBM PS/2 Model 80-111 and Compaq Deskpro 386/20

The steeping glant awakes: Hewlett-Packard's flamethrower ranks among the fastest PCs you can buy. Compaq's sophisticated memory management scheme keeps the Designo 386/20 up front on raw computing power, but the HP Vectra RS/20 matches Compaq's hard disk.

The NOP benchmark test is designed to measure raw clock speed and memory access time white minimizing differences is microprocessors and the effect of memory coching. This test executes admest nothing but NOP ("No Operation") machine code instruction in a big 128K loop. the time I takes to sescels a selected series of processon-interests leads. The test program uses 60056 instruction code. These instructions are a subset of the total processor instruction set. The 60056 indiruction Mi implements a number of 32-bit operations, in the 60056 processor these become single instructions, whereas in the 5006 and 50256 versions of the benchmark sout the creams nustible instructions. The BIOS Disk Seek benchmark test measures the filt takes to do a random seek using the disks ROM BIO The test result includes minimal software overhead armay not parallel the manufacturer's claimed average osset time. The test program performs 1,000 seeks. To

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you have an army of fonts et your fingertips.
If you're using Aldus Pagemaker* or Ventura Publisher*, you're ready to use Glyphix.
(Any package that can read HP soft fonts
cen manege Glyphix fonts.)





Software with capability. And credibility.

GLYPHIX				
HP		\ \	\	
Bitstream	$\overline{}$		1	YES
FONTS TO 60 POINT	YES	NO	Z	YES
FONT SCALING	YES	NO	Z	14
DEGREES OF BOLD	2	2	Z	YES
PATTERNED FONTS	NO	NO	Z	YES
300 x 300 DOT QUALITY	YES	YES	/	:16
TIME TO CREATE 30 POINT FONT	1:34		1	\$9995
PRICE	\$19500	\$20000	7	

Let the Glyphix Basics lead yy The Basics is a collection of four typeface outlines, each representing one of the major lettering styles. Roman, our version of Times Romer", is e clessical serif face that hes become a standard for body copy. Helvette, our version of Helvettca", is a modern sans serif

Ou through the pearly gates.
Chancelor is a decorative face
thet reflects a cursive hendwritten
look. And rounding out the family
is Rockland, e versetile squere sent
font thet commands ettention in
headline and body copy.

hes become a standard for body copy. Helvette, our version of Helvetica*, is a modern sans serif fece designed for presentations end headlines.	headline end body copy. The Glyphix Besics. The Glyphix Font Managers. Products that give your documents e look of celestial beauty. Order yours today.
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(800) 2: IN DELAWARE C. Include \$5.00 shipping and handling	OLL FREE: 37-9383 ALL (302) 733-0956 for one item. \$2.50 each additional neal, Box 5773. Willimington, DE 19808.

More Font Effects to Dazzle The Screen and Printed Page

PR HANDS ON

BY EDWARD MENDELSON

Are you tired of Helvetica Bold in all those headlines in your desktop publications? Soft-Craft's \$95 Font Effects takes any bit-mapped soft font and transforms it into a subtle or outrageous variation on the original. You can modify any HPstyle bit-map font for the LaserJet or work from Soft-Craft's fonts for either lasers or dot matrix printers.

Two-Toned Fonts

Font Effects lets you replace the funereal black of existing fonts with an unlimited range of patterns, outlines, and shades-anything from bold strines to checkerboards to fine weaves. You can put frames or shadows around characters or make fonts print out as whiteon-black. You can even create two-color fonts by printing fonts and shadows senarately on a color printer. Font Effects works only with bit-mapped fonts. Users of PostScript outline fonts can get similar effects from Corel's Newfont (see review next issue).

Automatic Installation

Modifying fonts takes time, but a screen preview mode lets you save time and paper, and you can save even more time by modifying only a few characters rather than an entire font.

But you won't want to modify a font if you then have to en-



SafrCraft's WYS1fonts! cames with programs to install screen and printer fants far both PageMaker and Ventura Publisher desktop publishing packages.



Six headline fants and two styles of Baskerville from Bitstream's new Fostwate Type face Packages, seen here in a PC Paintbrush file. The screen fants are, of course, at a much lower resolution than that of the printer fonts

> elegance or sharpness, but they do the job.

> font before you can modify or

install it. The best engine for creating soft fonts is still Bit-

stream's Fontwore Typefoce

Packoges, which creates bit-

map fonts for LaserJets or out-

line fonts for PostScript printers

and installs them in either Win-

dows or Ventura. Bitstream's

You have to buy or create a

dure the headache of installing it manually in Microsoft Windows, PogeMaker, or Venturo Publisher. SoftCraft's \$95 WY-

SIfonts! automatically installs all your printer fonts, no matter where you got them, and even creates a screen font to match each printer font. These screen fonts won't win any prizes for

Modified Modified

Variations on Bitstream's new Baskerville fant, achieved using Font Effect

Fontwore also creates screen fonts when it creates printer fonts, but unlike WYSIfonts!, Bitstream's package can't derive screen fonts from fonts you already own or from fonts modified by programs like Font Ef-

fects. SoftCraft sells a version of Fontwore that creates bit-map printer fonts only, but in a much greater variety of character sets than Bitstream's. Both versions use separate typeface packages as raw data for creating individual fonts. Bitstream has just issued ten more of these packages, including an elegant Baskerville and a variety of eyecatching headline styles. You may never use Helvetica again.



Font Effects WYSHonts! SoftCraft Inc. 16 N. Carroll St., #500 Madison, W153703 (800) 351-0500 (608) 257-3300 List Price: Font Effects, \$95; WYSHous!, \$95. Requires: Microsoft Windows

In Short: Fort Effects offers extravagant special effects for HP or SoftCraft's dot matrix bit-map fonts. WYSIfonts! produces screen fonts to match existing soft fonts for Windows or Ventura. Not copy protected. CIRCLE 441 ON READER SERVICE CARE

or Ventura Publisher, DOS 2.0

Fontware Typeface Packages Cambridge, MA 02142 (617) 497-6222

(Also available from SoftCraft List Price: \$195 each. Requires: Bitstream's or Soft-Craft's Fontware font-creation

In Short: Make-your-own soft fonts in ten new styles; 20 other nuckaces already available. Not convenuented CIRCLE 442 ON READER SERVICE CARD

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PIPELINE

Top Ten Sellers t's not often that Lotus 1-2-3 loses its number-one posified after 2 or 3 weeks. Tax J.K. Lasser's Your Income Tax season generates that kind of Simon & Schuster Software tion in PC software sales. Major sudden wave ungrades of other popular an-Tax preparation software al-Quicken 2.0 plications will sometimes ways ships later than its pub-Intuit shoulder their way to the top lishers would like, since the when they're first introduced, IRS publishes final guidelines Lotus 1-2-3 2.01 late in the tax year (usually but 1-2-3 regains the top Lotus Development Corp. spot as soon as the pent-October or November), Programmers then rush to get their up demand is satisrdPerfect 4.2 packages ready for the public. WordPerfect Corp. By the time the programs are finally bug-free (this year, it Turbo Pascal 4.0 Borland International Inc. was in late January), John Q. Publics across the country are lined up. Sylvis Porter's Swiftax J.K. Lasser's Your Income Timeworks Inc. Tax and Sylvia Porter's Microsoft Windows 2.03 Swiftax have gotten out of the block the Microsoft Corp. IN PERSPECTIVE PFS:First Publisher Software Publishing Corp. The Top Ten Sellers list ranks PC business programs according to their sales PC Tools Deluxe performance in the last week of a 5-week pe-Central Point Software riod. It also tracks programs' rankings over time, in this issue (reading left to right) from December 21 QuickBASIC 4.0 through January 22. A 5-week history is charted to give a Microsoft Corp. sense of a program's sales strength over time. Dramatic shifts in a particular program's ranking may be the result of sales promotions conducted by individual retailers. Or seasonal factors, such as end-ofyear-budget purchase decisions, may play a large role in the performance of a particular program in any period. More than 12,000 individual locations conon net sales by unit; returns are subtribute to the list tracted from gross Sales information compiled by Ingram Software Inc. How do you learn SURVEY new software? Some 1,285 callers to the PC Magazine Interactive Reader Service answered our request to rate the various ways of learning software. Despite what the people who answer the tech help lines at software mpanies will tell you, reading the manual is still idered the best way to learn The general consensus is that going back and forth between the manual and experimentation is the preferred method Probably the biggest surprise was the answer to our "obstacles-to-learning" question. A mere 59 percent of the respondents said poorly written manuals were the greatest obstacle; we expected even more doc bashing. Many people added the comment that "lack of time" was their greatest Consult an expert user Reed a good "guide" book problem. To that we add: amen

Experiment on your own

fastest, but ChipSoft's Turbo-Tax is not far off the pace at number 17.

Lasser is an annual bestselding and ground in recent yeared ground in recent tax is debuing with the '87 tax year. It's part of a new series from Timeworks that features the syndicated newspaper columnist's advice spread over three modules: tax help, investment management, and personal finances (see After Hours, PC Magazine, November

ber 24, 1987). Celebrity names are starting to work for software just as much as they do for other consumer goods: Chuck Yeager's name on a flight simulation game helped that program outsell the ever-popular Microsoft Flight Simulator within 2 months of the first shipments. It's proved so successful that Electronic Arts tapped Earl Weaver to consult on a new baseball game. The rumor mill says that John Madden and Michael Jordan will soon put their names on sporting games. Another personal finance

Another personal finance package is also in the Top Ten this time: Quicken, a \$49 checkbook manager. It's always been a strong seller that

WAITING IN THE WINGS

The head-to-head compension between Borland and Microsoft for programmers: loyalties rages on, with only the languages changing. Borland's update to the wildly popular Turbo Pascal has given it the upper hand for the moment, and the 1.5 release of Turbo C (essentially abug fix for the very sloppy initial release) is doing well at number 16 on the list.

But Microsoft has some cardy it's getting ready to show: a slew of languages for OS/2. The first releases won't provide access to OS/2's interprocess communication and multiple thread of execution calls. The big challenge: writing a fully fleshed-out OS/2 language and selling it at a fair price.

has flirted with stardom, and this issue's results will probably turn out to be a statistical blip. Quicken's rank is usually somewhere between 10 and 25.

VGA Making Its Way, Slowly Sales of VGA hardware have been less than brisk since the first boards for PCs and ATs appeared last fall. The likely reason: all of the players haven't vet checked in. Paradise, which did very well with its betterthan-EGA standard, has run into some last-minute technical difficulties on its VGA board and is still not shipping it. Since Paradise took a very firm stance early on that the board would be hardware compatible with IBM's adapter while others started to ship boards compat-

ible only at the BIOS level, a wait-and-see attitude has developed at the cash register.

That waiting may be extended by the news that Trident (a start-up fueled by renegades from Genoa) is ready to ship VGA chips that it claims are five times faster than IBM's chips. Trident has to convince board makers that the chip's extra speed is worth the risk of going with a newcomer rather than sticking with tried-andtrue graphic chip designers like Chips and Technologies, Tseng Labs, and Paradise. So Trident's design may never make it into a board you can buy, but it could be a factor by

the end of the year.

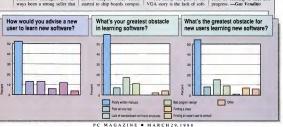
The really sad part of the VGA story is the lack of soft-

ware running in VGA's hi-res (640 by 480) graphics mode, which uses 16 colors out of a palette of 262,144.

IBM dazzled everybody with colorful demos last April, but software publishers are still waiting to see more VGA in the field before they put any more irons in the fire. Somebody ought to clue them in: software sells hardware.

Final Pit Stop for the 286 The evolution of 286 PCs seems

to be in its last cycle. AMD (Advanced Micro Devices) still can't deliver 16-MHz 80286 chips in volume. They're trickling out, and many compatible makers have resorted to the old trick of using slower (12-MHz) chips that hold up under testing at 16 MHz. And now AMD finds it can't raise the cash needed to carry out its plans for 24-MHz 286 chips. Also a factor: fear of Intel's long-awaited P9 chips, the 80386-compatible processor that was rumored to be pin compatible with 286s but is now said to plug into the 286 socket via a small adapter board. The future belongs to the 386, and ever since Intel cut AMD out of that market there's been no funding to fuel 286





Disk Optimizer. The original un-fragment software now has un-format. Un-believable!

It's still the safest, most effective way to put the zip back in hard disk performance. For more than two years now, Disk

Optimizer has helped PC users everywhere safely restore and maintain the smooth, slick fast performance of their hard disks. And now there's a new and improved

Disk Optimizer that un-fragments files even more effectively. And includes enough additional disk management tools to make it one of the best software values anywhere.

So, who needs Disk Optimizer, anyway? Simply everyone who owns a hard disk and relies on the speed and convenience it gives them

That's because DOS is constantly slowing your hard disk down. It does it by breaking files up into pieces. Storing different chunks in different places. And that makes everything slower - loading, sorting, retrieving, backing up - because your hard disk has to chase all around to read and write different pieces of your file.

Disk Optimizer restores the speed of your hard disk by putting files back together in one contiguous piece - where they belong.

Disk Optimizer is absolutely, positively "disaster proof."

It's sad but true. Some other unfragmenting software could lose your data if something goes wrong in the process. Like a routine reading or writing error. Or even a

power failure. But have no fear with Disk Optimizer. Nothing will go wrong because nothing can go wrong. Even if you yank the plug from

the wall in the middle of the program. It's because only Disk Optimizer copies each file, piece by piece, then checks the newly un-fragmented version for completeness. Only then does it go back and erase the fragmented version. Not power spikes. disk failures or DOS errors-not even earthquakes - can cause data loss. And only Disk Optimizer makes you that promise. So why trust your disk to anyone else? It's like a precision tune-up for your disk.

In addition to un-fragmenting, Disk Optimizer also lets you quickly choose the optimum layout for your disk. So your most-used files have the fastest access. And program and other unchanging files can be permanently un-fragmented and set aside on their own area on the disk.

The simple menu makes it a snap Un-format - one of the powerful new reasons to buy Disk Optimizer

Oops! Make a simple mistake at the keyboard and you could wipe out your hard disk with a DOS Format command. But don't worry. "Un-format" will recover your entire disk, and all your data, in just moments, It's included with your new Disk Optimizer.

Plus, you get the new "Analyze" progra with a graphical display that shows your disk's condition so you'll always know when it's time to optimize again. You also get "Sorts" for organizing directories for the best appearance and sequence. "Findfile" for searching out hard to find files. "Delfile" for locating and erasing unwanted files. "Lock" and "Unlock" for file security. And more.

You could spend hundreds on other utilities and still not get all the functionality packed into Disk Optimizer at no extra charge. Use it once and you'll discover what nearly 200,000 users already know-\$69.95 is a small price to pay for the speed, convenience and safety you get only with Disk Optimizer.

Look for the new Disk Optimizer at software dealers everywhere. Or order directly from SoftLogic Solutions by calling us toll-free.

Just a few of Disk Optimizer's rave reviews: Selected PC Magazine's "Best Of The Best" utilities. I find Disk Optimizer excellent. Disk access, even at 4.77MHz, is much faster

And leading 100 Fontasy fonts now takes seconds.

Elizabeth Joan Devic, Indiana "I feel this is essential software for anyone with a hard drive."

D. Sorenson, Texaco, California

"Easy to install, use, and most importantly, it works!" - Dan Neilsen, General Electric Information Systems, NY Optimizer § 69% SOFTLOGIC SOLUTIONS

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\$195 Brief: The Right Tool for Editing Code

PE HANDS ON BY HOWARD MARKS

Some PC users live by an old saying that goes: when all you have is a hammer, everything looks like a nail. They use 1-2-3 as a word processor and use word processors to edit their program code.

A professional carpenter knows the value of proper tools, and a professional programmer is likely to prefer a programmer's editor for code writing.

The difference between a word processor and a programmer's editor is rooted in the difference between programs and the written word. The basic units of English documents are words, sentences, and paragraphs, while program files are made up of lines. Therefore the features of a good word processor (like left margins and word wrap) get in the way while you edit programs. In addition, most word processors keep their files in unique formats, while the language programs that process program files require ASCII

Brief lets you open as many



program code, but the macro functions are remarkable.

windows as you like into different files or into different areas of the same file. Changes made in one window are automatically reflected in any other open win-

Unlike most editors' limited undelete function Rrief's undo can reverse almost any command, including block moves. You can mark blocks by column, character, or line and then perform all sorts of manipulations on the marked block. You can search and replace (which

Brief calls "transform") on the block, move it, and even convert the whole block to upper-

Brief's macros are incredible. You can remap the keyboard, fix your program's indentation, or anything else you can think of. You can even assign macros to keys and use them as if they were built-in Brief commands

You can even set up Brief to return to the same exact spot in the program you were editing

Brief is handy for C programmers, since it automatically indents their programs for maximum readability.

Those of you still using WordStar to edit your programs will be amazed at how much easier it is to use the right tools for the job.



Brief, Version 2.01 Solution Systems 541 Main St., #410 South Weymouth, MA 02190

(617) 337-6963 List Price: \$195 Requires: 192K RAM, two disk drives (hard disk recom-

In Short: A very powerful pro grammer's editor. Strong points include unlimited windowing, support for EGA 43-line mode, nuacros, full undo, and automatic indenting. Strongly recom-

mended. Not conv protected.

CIRCLE 463 ON READER SERVICE CARD

C-Scape Library Takes the C Screen Work Out of Your Hands



HANDS ON

BY STEPHEN RANDY DAVIS

It didn't create major waves when it was first released, but the second version of The Oakland Group's screen management program, C-Scape, could send C programmers reeling.

C-Scape is a library of some 200 procedures that will simplify the rapid creation of attractive and flexible text menus under any of the popular C compilers. C-Scape is well thought out, using object-oriented techniques based around the "printf" concept familiar to C programmers. Included with C-Scape is an improved version of Oakland's screen designer and code generator, Look &

the pop up, pull down, or exploding variety (with free choice of border), and they may be stacked on top of each other. Menus created with C-Scape are limited in size only by available RAM-C-Scape auto-scrolls menus onto the available 80column and 25-, 43-, or 50-row

display. You have full control

of each of the fields within the

menu, and you can define your

Individual menus may be of

own data types for individual fields using C-Scape's field functions. C-Scape does not support graphics display modes or rodent input The Look & Feel display

editor reduces display development time by taking displays and generating C programs (containing C-Scape calls) to produce them. Look & Feel-generated C programs can be edited and fine-tuned. Look & Feel also accepts screens generated by Dan Bricklin's Demo Program

C-Scape comes with 500 pages of clear documentation. No royalties are required for



C-Scape (with Look & Feel) The Oakland Group 675 Massachusetts Ave. Cambridge, MA 02139 (800) 233-3733 (617) 491-7311

List Price: Borland Turbo C and Microsoft C Versions (object only), \$99.95; source code version, \$279; demo disk, \$10. In Short: An involved but powerful screen-handling package

for C. Not copy protected. CIRCLE 462 ON READER SERVICE CARD programs developed using C-

Scape. In addition, you can purchase C-Scape's source code. An inexpensive demo disk is available to the skeptical.



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A Suite of Calculators: Dalin Wheels Easy to Use, Expensive



BY BARRY SIMON If someone offered you a set of

wheels, you'd probably have visions of a souped-up sports car. but Dalin has introduced a tricycle-three software packages called Daily Wheel, Scientific Wheel, and Professional Wheel. Each is a set of several individual calculational programs with only a command set in common, but without the ability to exchange data.

The Wheel programs support the basic scientific functions and also let you type in complete formulas to be evaluated and then changed with a fullscreen editor

Daily Wheel comes with a pop-up resident program (taking 150K and offering unit conversion and calculator modules) and a more versatile standalone calculator. Scientific Wheel comes with a pop-up taking 160K, similar to the one in Daily Wheel, and a lovely standalone function analysis module. Professional Wheel consists of four standalone programs: enhanced versions of the Daily Wheel pop-up modules, a ! "function calculator," and a statistical analysis package.

My favorite module was the function analysis from Scientific Wheel. You type in a function of one variable and its limits, and the module computes all the zeros, the maxima and minima. and all the inflection points. Plus, it graphs the function or even does a numerical integra-

tion or differentiation. Each program is slickly presented, but severely limited.

Often, the functions are restricted to a single variable. The number of lines in any "worksheet" is not large, and the cal-

culator doesn't have true variables. The statistical analysis module is limited to 200 data points and cannot import from other programs. All the programs' features

are available in more-powerful versions elsewhere. For example. APL and Point Five give more-flexible full-screen formula editors, and Fareka.



Professional Wheel, Version I 0 Scientific Wheel, Version 1.0 Daily Wheel, Version 1.0

Dalin Inc. P.O. Roy 33308 Granada Hills, CA 91344 (818) 360-7058

List Price: Daily or Scientific Wheel, \$99.95 each: Professional Wheel, \$199.95.

Requires: 256K RAM for Dai-Iv/Scientific . 384K for Professional: CGA, EGA, or Hercules for graphics modules; DOS 2.0 or later

In Short: Each package is a collection of several well-done but limited calculational programs. ORCLE 439 ON READER SERVICE CARE

MathCAD, and TK! Sulver find roots of equations in many variables, rather than just one. The one virtue of the Wheels is that they really are easy to use.

The price of the combined Daily or Scientific/Professional Wheels is essentially the same as the price of MathCAD. In terms of the price/performance ratio of other scientific packages. I can only conclude that the Wheels are considerably overpriced.



Bertion points, and a reach when you ever it the function of a variable and its limits

Ashton-Tate Free Space Puts More in Less

HANDS ON

BY EDWARD MENDELSON The classic study of hard disk organization is the stateroom scene in the Marx Brothers' film A Night at the Opera.

Before your disk gets as nacked as Groucho's first-class cabin, it's time to think about data compression. Ashton-Tate Corp.'s \$69.95 Free Space (written by Stoneax Associates) squeezes data files to half their normal size and does it automatically and transparently. It doesn't make you issue a command to pack a file or unpack it

later-but it's smart enough to compress only the data that you want to squeeze. Free Space creates a read-

only DOS file up to 2MB. It tricks DOS into treating the file as a new disk with its own drive letter. When you write a file to this new "disk," the memoryresident part of the program compresses the file. When you read the file, the program decompresses it. You copy files to and from this new "disk," just as you can with any other disk. If you ask DOS for the "disk's" directory, it reports the uncompressed sizes of the squeezed

An optional security system makes the compressed "disk" accessible only if you type in a password at boot-up. And you can have multiple "disks" with

separate passwords for each. Free Space is so elegant that Margaret Dumont might want to keep a copy on her jewel-encrusted lanton.

FACT FILE

Free Space Ashton-Tate Corp. 20101 Hamilton Ave Torrance, CA 90502-1319 List Price: \$69.95 Requires: 55K RAM, one disk

drive (hard disk recommended), DOS 2 Loclater In Short; A transparent filecompression utility. Not copy protected. CIRCLE 440 ON READER SERVICE CARD



ntroducing Quicken* Version 2absolutely the fastest, easiest way to write checks, keep financial records, track income and expenses, budget, and manage your cash flow. It's ideal for business and personal use.

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- Analyze budget vs. actual expenses by month for 12 months: 4 seconds
- Look up a check you wrote 1000 checks ago: 1 second Write and print 20 checks and update all
- records: 3 minutes Compile an itemized list of tax deduc-

tions for the year; 3 seconds How can it be so fast? Quicken uses indexed files and speed-optimized C and assembler code - the very latest in high-speed technology.

So Automatic, It Eliminates Work. Quicken's fully automatic "macros' eliminate repetitious clerical work. Macros



Quicken remembers the bills you forget.

remember your bills, print your checks, and update all records automatically. All you do is sign the checks.

In fact, Quicken is so automatic it reminds you to pay your bills even if you forget to use it! Simply turn on your hard disk PC, and Quicken's pop-up Billminder" appears when you need to pay bills.

No Need to Alter

Your Bookkeeping Procedures. Quicken is easy to use because it works just like your checkbook. There's no need to change your bookkeeping format or learn anything new -- no accounting jargon, no "debits," no "credits."

Quicken also comes with comprehensive on-line help, a complete manual, and free technical support.

Here's what the critics say: "I've never seen such an easy-to-use manual or software that's so simple to use" Martin Blumenthal, inCider Magazine

"Extremely simple and fast."

Esther Dyson, Industry Analyst

"Absolutely the best small accounting program made.

Bob Schwabach Universal Press Syndicate

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The U.S.A. on CD: Windows on the World Lets You Customize Maps, Build Your Own



BY DONALD TRIVETTE
A CD-ROM holds a staggering amount of data—so much, in amount of data—so much, in the stage of the stage of the space that is available. Now GeoVision, of Norcross, Georgia, has actually come close to using the entire capacity of a CD-ROM with its new GEO—date U.S. Adian of the United data—530,000,000 bytes—to display any place in the main-land United States, Alsaka, and

Hawaii to a scale of 192,500. GEOdate is a database that runs under GeoVision's Windows on the World software, which in turn uses the Microsoft Windows environment in order to manage the screen, mouse, and external devices such as printers and plotters. And because GEOdate, you excl. only of the soins, as well as DOS 3, 2 or later. Installing these layers of software is harder than it.



The southeastern region of North Carolina with overlays showing rivers and highways. The surveyor tool shows the distance in feet, kilometers, or miles between points, and the cursor distalcts its exact lonvitude and latitude coordinates.

sounds, and it took several attempts to get all the pieces working together amicably. But finally they did, and the installation was worth the trouble.

You select an area of the United States either by name from a gazetteer or by geographic region. A region contains several states, and once you display a region on a small scale, you can use the zoom command to pick an area to enlarge. To display a detailed map of southeastern North Carolina, for example, you would use the mouse to pull down the zoom menu and click one of the enlargement sizes that range from 2x to 64x; then move the cursor over the area of the map you want enlarged, and click again.

want enlarged, and click again. Within minutes a new map appears. At the largest scale, the screen width represents about 40 miles. Windows on the World has various options to customize and manipulate the graphical

and manipulate the graphical data. An overlay menu controls which features appear on the map, including bodies of water, water courses, highways, railroads, federal districts like national parks and military bases, and state and county boundaries. Text names and symbols can be shown for airports,

roads, and towns.

A Create option allows you to draw and label your own features—such as pipelines, easements, or property boundaries. Another feature lets you calculate the exact longitude and latitude of any point under the cross-hair cursor; at the same time, a surveyor tool calculates.

distances between points in

feet, kilometers, or miles as the cursor is moved across the screen. It's a lot like using a CAD/CAM system with geographical data.

Slow Transfer Rate

Although a CD-ROM holds a huge amount of data, it has a relatively slow transfer rate. It can take minutes for a detailed map to be drawn, so Windows on the World lets you save all the data for any particular region on a hard disk. Depending on the region, this may consume as much as 1 or 2 megabytes of the hard disk, but it speeds up map creation dramatically.

Windows on the World isn't without flaws and bugs—it's slow, and parts of the interface with Windows 2.0 are incomplete—but GeoVision is working to fix them and to put even more detailed data on compact disc. One day soon, we'll be able to display street maps and major buildings on our PCs. And then, in our cars.



FILE
Windows on the World
GEOdisc U.S. Atlas

GeoVision Inc. 270 Scientific Dr. Norcross, GA 30092 (404) 448-8224 List Price: \$495 each

Requires: 640K RAM, hard disk drive, 286-based computer, EGA or VGA, mouse, CD-ROM player and Microsoft CD-ROM extensions, Microsoft Windows (Version 1.0 or 2.0), DOS 3.2 or later.

In Short: A U.S. atlas on CD-ROM and accompanying software used to display, manipulate, and customize maps. Useful for those who work with geographical data. Not copy

ORCLE 454 ON READER SERVICE CARD

Free Tips from World-Class Programmers

Here's a deal you won't want to pass up if you've got even a passing interest in programming. Solution Systems is offering a free booklet, "World-Class Programmers' Editing Techniques."

It consists of short interiews with seven of the more-influential programmers in the short history of personal computing, including Wayne Ratliff, dBASE's first father; Walt Penney, a key designer of Dr. Halo; and that legendary duo Bob Frankston and Dan Bricklin, who wrote VisiCate together.

There's a crass commercial motivation behind this large's that's easy to excuse: all of them use Brief, the programmer's editor (see review of the latest version, page 43), which just happens to be published by the sponsor of this little booklet. But that's not all they talk about, and when they do talk about Brief, some of their comments are critical.

Here's Bricklin on building code into recyclable modules: "I try, but'it rarely works out that way. You end up with a code that is very 'barnacled' (that's a word that Bob Frankston uses a led."

Not all of the interviewees are as colorful as Bricklin, but at 15 pages, the booklet's worth

You can write Solution Systems at 541 Main St., #410, South Weymouth, MA 02190.—Gus Venditto



When you need to move quickly among programs and files, Software Carousel carries the load for you.

Why get dragged down by that old PC technology?

Despite the sophistication of today's PCs, there's one thing they still don't do. And that's work the way people work umping from one task to another - from adgets to memos to phone calls and back. So every time you need to change

programs-or just look at another file-it's the same old, tiresome routine-saving, exiting, loading, retrieving. Not very convenient. Not very human. Now you could wait for the "next generation" of computers. Or use Software Carousel, and get the speed and convenience you need today, with the software, and computer, you already own. Here's how to make Software Carousel work for you.

Software Carousel is the amazingly easy way to switch almost instantly from Word-Perfect to 1-2-3 to dBASE to DOS to whatever else you want. Or go from one file to another in the same program. All without saving or retrieving-or wasting a precious moment of your time. Or your computer's memory.

It works by creating a number of independent software slots to load your programs into. You get up to ten of these software

slots, so you can load up to ten programs Need to crunch numbers? Hit a key and there's your spreadsheet. Need your word processor? Don't bother saving your spreadsheet file. Just whip over to your document and do your work. Snap back to your spreadsheet and it's just like you left it. It's like all your programs are "pop-ups," just a hotkey

Or load the same program into a few different slots, each with a different file. Now go from one to another in an instant.

Here's the best part of all. You may have heard about some other "environment" programs that claim to do something similar to Software Carousel. But there are several important differences. First, they make you split your memory

up among the programs you want to use Software Carousel lets you use all available memory in each and every program. It even supports expanded and extended memory. Other environment programs work with only some software. Software Carousel

works with everything. Period. It even resolves conflicts among memory resident

Other software creates a working environment that's complex, unfamiliar, with cramped little windows and strange commands. Software Carousel takes minutes to ser-up just the way you want it. All your software looks and acts exactly as it always did.

It's so downright useful, even IBM* recommends it. Even as you read this page, there are tens of thousands of Software Carousel users zipping through their work without laborious

and repetitive commands. And without the usual 640K limit imposed by DOS. In fact, even IBM recommends Software Carousel for use with their most popular mainframeto-PC communications package We think you'll agree, that with this

kind of speed, convenience, and nextgeneration performance, \$79.95 is a small Look for Software Carousel at software

dealers everywhere. Or order direct from SoftLogic Solutions by calling us toll-free. lf, after thirty days, you're not satisfied that Software Carousel is the right way to get that old PC technology off your back, we'll gladly arrange for a refund of your purchase price.

Here's what people are saying about Software Carousel: "Can't believe how well it works. Who needs 80386?"

-Raigh Evens, Attorney, Fullerton, CA

"Unlike other attempts (e.g. MS Windows, DesqView) yours works, is not fragile and does not intrude its "personality" on everything that we do."

-Colin Raiph, Raiph & Pauer, Inc., South, WA

"Fantastic program. Great book. Saves me an hour a day! Thanks." - Larry Pearsal, Rolling Hills Covenant Church, Rolling Hills Estates, CA "Solved all my problems with resident software."

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NEW ON THE MARKET

MatrixPlotter from Insight Development Turns Your Dot Matrix Printer into Plotter

Insight Development Corn... which developed LaserPlotter to enable laser printers to plot HPGL output, has now done the same for 18- and 24-pin dot matrix printers.

MatrixPlotter accepts vector graphics files and converts them into bit-mapped raster images that print out at the highest resolution of your printer. The program has drivers for the Toshiba 300 series, Epson dot matrix printers, and their compatibles.

The self-configuring program uses a pop-up menu user interface to set options-such as patterns or gray-scale to represent the colors that a plotter would output-line width, and resolution.

List Price: MatrixPlotter, \$99. Requires: 128K RAM, 18- or 24pin dot matrix printer (call company for compatibility information), DOS 2.0 or later. Not conv protected. Insight Development Corp., 1024 Country Club Dr., #140, Moraga, CA 94556; (415)

376-9451 CIRCLE 444 ON READER SERVICE CARD



sight Development's \$99 MatrixPlotter enab using either a 24- or 18-pin dot matrix printer

Logitech's New HiREZ Mouse Has Resolution Of 320 Dats per Inch

Logitech says it's the first firm to offer a mouse like HiREZ, with its sweeping resolution of 320 dots per inch.

The three-button varmint uses 62 percent of the desk space a standard 200-dpi mouse would use for an equivalent cursor move.

It costs \$149 and works with any software that requires a mouse, including the Microsoft Mouse standard, according to Logitech. Logitech includes two driv-

ers, a pop-up menu creation utility, menuing for 26 applications, a 1-2-3 driver, and a text editor called Point List Price: HiREZ, \$149.

Requires: 256K RAM, DOS 2.0 or later, Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555: (415) 795,8500

CIRCLE 448 ON READER SERVICE CARD



Louitech's \$149 HiRFZ Mouse permits factor cursor motion with its 320-dot-per-inch resolution, suiting it to use with high-resolution monitors

DartCard Furnishes Up To 704MB RAM. Mounts in a Drive Bay

A memory expansion system that mounts in a half- or fullheight disk drive bay has been announced by Newer Technology, of Wichita, Kansas.

Memory boards of 4-, 16-, or 64MB capacity are available. Up to five of these boards can be installed in a half-height rack, and up to 11 in a full-height, for a total of 704MB, Four Dart-Card racks can be daisy-chained in an external chassis for a grand total of 2.8 gigabytes.

Different "personality mod-ules" allow the DartCard to be used with an AT-bus multifunction interface, SCSI, and ESDI. The AT-bus interface and

controller yields nonvolatile hard disk emulation and up to 15MB of AT extended or 8MB of LIM expanded memory. The SCSI module means DartCard works with Macintoshes et al... and ESDI lets you use it with

Power for the unit comes from the system, external AC, or a battery pack. List Price: DartCard, half-height starter kit with 4MB RAM and controller card for XT or AT, \$2,595; \$50 extra for full-height rack: 4MB memory boards, \$1,395 each: 16MB memory boards. \$9.995; external chassis and controller, \$695. Newer Technology. 1117 S. Rock Rd., #4, Wichita, KS

67207: (316) 685-4904 CIRCLE 447 ON READER SERVICE CARD



DurtCurd gives you up to 704MB RAM for extended, expanded, or RAMdisk memory. It can occurs a disk drive but or its own chassis.

LAP-LINK Mac Connects PCs and Apple Macintoshes at 57,600 bos

Bothell, Washington, the maker of Lap-Link, is offering a utility that transfers files between Macintoshes and IBM Personal Computers, including PS/2 models. Traveling Software claims its Lap-Link Mac is the fastest IBM-to-Mac data transfer program available.

The \$139.95 Lap-Link Mac transfers files at 57,600 bits per second over a cable that connects to standard serial ports. The software splits the screen into two windows, one side showing the files on the Mac and the other on the PC. Traveling Software equips

Traveling Software, of | Lap-Link Mac with options for converting Microsoft Word. MacWrite, WordPerfect, Excel. and PageMaker files into the target machine's format. The manufacturer encloses both 31/2and 51/2-inch disks for the PC, a 31/2-inch Mac disk, and a 6-foot connecting cable.

List Price: Lan-Link Mac. \$139.95. Requires: 256K RAM on the PC or PS/2 and 128K RAM on the Macintosh, one disk drive, DOS 2.0 or later. Not copy protected. Traveline Software Inc., N. Creek Pkwy., Bothell, WA 98011; (206) 483-8088.

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Numerikeys Brings Extra Keys to Laptops

HANDS ON

BY NEIL J. RUBENKING Each laptop computer takes a different approach to jamming all the necessary keys into too little space. The one I'm typing this article on has four arrow keys set in a baseball-style diamond arrangement-you press an "Fn shift" key to turn the arrow keys into PgUp, PgDn, Home, and End keys, Even worse, the numeric keypad overlays a section of the stan-

quires use of the Fn key. If you haven't got enough frustration in your life, try working on a spreadsheet with this setup! Genest Technologies has solved this problem. Its \$129 Numerikevs is an external numeric and cursor keypad with a

dard typing keys and also re-

keypad and a set of arrow keys in the inverted-T arrangement.

<Exc>, < Alt>, < Home>, | <End>, <Ins>, , <PgUp>, <PgDn>, <Ctrl>, <Tab>, and an assortment of

punctuation keys. You access the function keys (which share space with the number keys) by pressing < Shift > and the corresponding number key. Numerikeys doesn't have

the click of the IBM keyboard. but it has a firm touch. Users who prefer audible feedback can set a software click at three volume levels. Numerikeys is equipped with its own keyboard macro program, NUMPATCH, Using the NUMPATCH configuration program, you can assign a string of up to 15 characters to each key or valid key combination.

You connect Numerikeys to your system's parallel printer port. If you're using a printer, just unplug it, plug in the Numerikevs connector, and plug the printer into the connector. A tiny (5K) RAM-resident program tracks the keypad input and feeds the keys into the com-

puter's regular keyboard buffer.

The 41/2- by 9- by 1/4-inch unit comes with a black leatherette case that matches the spiffy laptop image and fits in the pocket of my laptop bag.

If your laptop's keyboard is driving you mad, or if you want a separate numeric keypad for your 83-key PC, Numerikeys will do the job.



Numerikevs Genest Technologies Inc. 1331 E. Edinger Ave. Santa Ana, CA 92705 (800) 826-9641 List Price: \$129

Requires: PC-compatible com puter with parallel port. In Short: An external 33-key numeric keyboard for laptop or desktop PCs CIRCLE 432 ON READER SERVICE CARD

total of 33 keys There's a complete numeric Genest Technologies' Numerikeys is an external, 33-key numeric and cursor keypad There are <Shift>, <Enter>, that is designed for lanton compaters with crossled keyboards

How to Play the Game: For Managers Only

PR HANDS ON

BY WILLIAM A. TAYLOR When many companies install PCs on a large scale, they appoint a manager of end-user computing (EUC) to support the new systems. N. Dean Meyer, a consultant to corporations making such a change, claims that most EUC efforts fail for political reasons, because most EUC managers know more about technology than the politics of technical innovation.

Meyer has crystallized his approach into Game Plan, a decision support program that puts you into a gamelike challenge. As the EUC manager of a firm, you take actions month by month, are confronted with political reactions to your moves, and are assigned credibility chips for each month. As you gain chips, you gain power and tively. As you lose chips, you become ineffective and ultimately lose your job. First, you describe your cor-

porate culture as futurist, consensus, profit centered, or traditional. Knowing your culture helps Game Plan award you the right number of points per move. A futurist culture values risk, so you will not get many points for introducing a standard application even if it saves a lot of money, while reducing costs gets more points in a traditionalist firm.

Game Plan then asks if you would like to take any actions at

the beginning of each month. You can initiate projects, write policy statements, ask for more staff, install a network, form steering committees, or do other things that gain or lose you credibility points. Starting any action costs points because you have to get approval. Any payoff comes later when the action is completed.

At the end of each month, Game Plan notes any activities that ended and awards you points accordingly. The goal is to earn 50 credibility points and get appointed vice president.

Game Plan is easy to use, but it is limited. When you try to resume an old game, you get no list of existing files and have to quit the program to look at a directory. There is on-line documentation but not enough-you have to read the manual pretty thoroughly to make sense of the program.

It is hard to play "what if" games, which ought to be the point of Game Plan. You can save a partial game in a file and replay it from that point to try different strategies, but you'll have to keep track of the results in your head or print out the dif-

Still, the program offers keen insights that can help you avoid political mistakes.



Game Plan. Version 2.0 N. Dean Meyer and Associates Inc. 233 Mountain Rd. Ridgefield, CT 06877 (203) 431-0029

List Price: \$495 Requires: 512K RAM, one disk drive, DOS 2.0 or later. In Short: An expert system that simulates the political reactions to your efforts to introduce new office automation. Not conv

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Rusel DeMaria, PC Week 33

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OUICK LOOKS

HP-16C Emulator: It Ain't Pretty but...



As any programmer will tell you, there is usually a trade-off between power and ease of use. XACT-16C, from CaleTech. presents just such a dilemma.

It's an emulation of the HP-16C calculator for which it is named and has many of the built-in functions and features that programmers demand. But its user interface is a bit cluttered, and the sheer variety of features makes it an unlikely choice for someone who just wants some pop-up help with balancing a checkbook. The right and left shift keys distinguish among functions.

The calculator can be run either as a standalone program or as a memory-resident pop-up.

Its interface is an on-screen diagram that imitates the layout of the actual HP 16C, with calcula-

white keys on the PC keyboard. Each key has three functions. The Right and Left Shift keys tor functions mapped to the distinguish among functions.



You must be pilet to hold your HP-16C calculator in your hand, but can the HP-16C colvalistor non an over PC-Talk like XACT-16C does?

Supported functions include logical operators, adjustable word size, and base conversions, as well as many of the usual mathematical features. With all that erammed into the display, it takes some time to figure out where everything is.

XACT-16C can be programmed to execute strings of calculator keystrokes, and a simulated paper tape can be popped up and printed. In addition there is a pop-up ASCII table. Results can be pasted from the calculator's display window to foreground applications.

It may not be pretty to look at, but it has power to burn. List Price: XACT-16C, \$49.95. Requires: 128K RAM, one disk drive. DOS 2.0 or later. Not copy protected, CaleTech, 13629 Bellevue-Redmond Rd., #202, Betlevue, WA 98005; (206) 643-

CIRCLE 433 ON READER SERVICE CARD

1682

FileScan: Bureau of Lost Filenames

HANDS ON

BY EDWARD MENDELSON A hard disk is like a havstack with a capacity of 20 or 30 meganeedles. Panther Associates' \$49.95 FileScan makes it easier to find the needle you need without getting bloodied in the

process. Packed with Options

FileScan is a fast, full-disk file searcher with more options than most similar applications. When you become familiar with the menu options, you can run it from the command line. You can search through an entire stack of floppy disks by telling FileScon to search first in drive A:, then in B:, then drive A: again. If you can't remember whether you need 1988TAX-.DOC or TAXDOC.88 or TAX-88.DOC, you ean search for all filenames containing "88."

You can choose to print or erase

any files containing a search | string or learn the disk space needed when copying those

files Microlytics' GOfer combines data searches with memory-resident cut-and-paste functions and searches at a marginally friskier pace. But if you prefer to work right from the command line, FileScon has all the features that you will need and many more. List Price: FileScan, \$49.95. Requires: 90K RAM, two disk drives, DOS 2.0 or later. Not copy protected. Panther Associates. Rae 1. 1014 Cimarron Circle, Rounoke,

TX 76262: (817) 379-5266

CIRCLE 434 ON REAGER SERVICE CARD

WordPerfect on a Leash, Part 2

HANDS ON

BY EDWARD MENDELSON MouseMenus for WordPerfect puts virtually every one of

WordPerfect's functions within easy reach of your mouse's whiskers. Unlike the Mouse-Perfect mouse driver (reviewed in First Looks, page 56, PC Magazine, September 29, 1987), MouseMenus' \$49 program almost never drops you from a mouse menu into a WordPerfect menu but instead lets you choose functions from one of its own mouse submenus. You never even have to bother hitting WordPerfect's cancel or enter keys-just touch a mouse button

Naturally you also get mouse-controlled scrolling, plus easy manipulation of blocks. Some of WordPerfect's existing menus require unintuitive, athletic jumps around the keyboard, so a mouse menu can save time and effort even for expert typists who hate to take their hands off the keyboard. The only loose hairs on this program appear in the overstuffed main menu, which includes 36

separate functions.

No mouse program can give WordPerfect the kind of symbiosis between mouse and word processor that Microsoft Word enjoys. But MouseMenas for WordPerfect comes closer than any other to getting all the cheese out of the trap.

List Price: MouseMenus for WordPerfect, \$49. Requires: Microsoft- or Logitech-compatible mouse; WordPerfect, Version 4.1 or 4.2. Not copy protected. MouseMenus Inc., P.O. Box 1020,

Brookline, MA 02146; (800) 641-3322. ext. 1020: (617) 964-0067. CIRCLE 435 ON READER SERVICE CARD

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Merely difficult problems Eureka solved virtually instantaneously; the almost impossible took a few seconds. Stephen Randy Davis, PC Magazine 44

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CIRCLE 189 ON READER SERVICE CARD

PC UPDATE

edited by Peggy Gavan

Saba Handscan

Saba Technologies has released Version 3.0 of the software for its **Handscan** data entry device. The new version offers several enhancements, including IBM and Data Products line printer support, expanded character substitu-



Upgraded software for the Soba Handscan adds IBM and Data Products line printer support.

tion options, new diagnostics software, and support for the new IBM keyboard. Current owners of the Handscan can upgrade at no charge. Saba Technologies, Beaverton, Ore.; (503) 626-7050.

Harvard Graphics, Version 2.1

Harnard Graphics, Version 2.1. adds many new features, including a 77.000-word on-line new features, including a 77.000-word on-line new features, incovered charles and the ability to convert chart elements to symbols for independent object editing. Harnard Graphics, priced at 5995, is available to registered users for \$50. Registered users of Harvard Presentation Graphics can upgrade for \$150. Software Publishing Corp., Mountain View, Calif.; (415) 962-8910.

Kermit, Version 2.3

The Kermit truor-checking protocol now mass on the entire line of IBM PCs, including the 198/2 series, and on several non-IBM-compatible machines such as the DEC Rainbow and Hewlett-Packard 150. Support for operation over NETBIOS-based local area networks, a script language for automated dialogues with other computers, and compatibility with interchecking the computers, and compatibility with interchecking the control of the computers, and compatibility with interchecking the control of the computers, and compatibility with interchecking the control of the computers of the computer of the computers of the computers of the computers of the computer of the computers of the computers

Primavision Version 3.0

Primavision. Version 3.0, features on-screen plots, a pure logic plot, mouse support, and full support of dot matrix and laser printers. In addition, the new version provides complete control of pen colors, bar fill, and letter and bar size. Upgrades to Primavision, priced at \$1,500, are free to registered users. Primavera, Bala Cynwyd. Par. 2(21) 667-8660.

ACT!, Version 1.1

ACT, Version 1.1, adds auto-dud capability and a faster, enhanced search function in its name, address, and contact information database. The new version can also maintain multiple databases and generate preaddressed memos and correspondence with automatic letter-headings. Upgrades to ACT; priced at 590%, are available to registered users for the control of the co

Microsoft Free!

Microsoft Corp. S. Exeel spreadsheet now supports local area networks, including BM's PC Network and Token-Ring Network, Novell's NetWare, and Scorn Corp. 's 2 Plan and Ether Series. The network version—which includes server and Exeel User Parks for each network user—provides File locking capabilities at the cell, password protection, and read-only files. Exert is priced at 5-905, and the user packs cost \$250 each. Microsoft Corp. Redmond, Wash : (20) 805-808p., Redmond,

TARGA 16

Truevision has enhanced the TARGA 16 videographics adapter board and slashed its price by \$1,000. The TARGA 16, now priced at \$1,995, provides simultaneous analog RGB



offers improved video output quality and a reduced price tog of \$1,995.

and composite video outputs, reduced power consumption, and improved video output quality. Truevision, Indianapolis, Ind.; (800) 858-8783.

IN BRIEF

Software Bridge, Version 3.0, supports 16 word processing formsk in addition to supporting forth between word processing formsk in addition to supporting forth between word processors, side-by-side and screpturing columns, and footnotes, resident supporting the supporting the

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TRAC FI		380K, 1/2 ht., 5.25", black for XT
Trace	D-TEA-55 ID-AT	360K 15 ht. 5.25", grey for AT
Pagasopole Pi	D-PAR-18475AT	1.2M, 1/2 ht., 5.25", grey for AT
Pagatoelc F	D-PAM-JUASS-2	360K to bt. 6.25" block for XT
Parasonic P	D-PAM-JUASSAT	380K % ht. 5.25", grey for AT
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Faritsa P	D-FRU-2555103	1.2M, 16 ht. 5.25", grey for AT
Panasonic Panaso	D-TEA-33FGVAT	1.2M. % ht. 5.25", grey for AT

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According to the January issue of Vis a Vis, the United Airlanes in-flight magazine, "Network cards enable the flaptup [composer to plug tota the cigaters."

Research and enable to large the major compare risk give me for the disperse disperse of the medical points. Detection of the control of the

The cover photo in Hewlett-Packard's Design Center magazine about Federal Express shows an AT&T 6300 PC being loaded on the FedEx plane.

Amazing Facts I

"Because Ethernet coaxial cable is physically larger than wisted-pair copper wire, networks using Ethernet have greater bandwidth, or capacity."

—MacWorld, January 1988

Amazing Facts II

"Another, more expensive option is the new 3½-inch harddisk drive. These pocket-size, high-capacity disks are beginning to supplant 5¼-inch disks and are recommended for firsttime buyers."

-Nation's Business, January 1988

Amazing Facts III

"A monitor's resolution is typically measured in dots per inch (dpi) . . . One of the newest graphics monitors is the Video Graphics Array (VGA), which boasts a standard resolution of 640 by 380 dpi . . . EGA has a resolution of 640 by 350

dpi"
—PC Week, December
22/29, 1987

Amazing Facts IV "[The Psion Organiser II] also

accepts such other RS-232 devices as an AC adapter"

—Lotus magazine, December 1987

Fearless Prognostication

"First-time buyers and repeat customers will comprise the bulk of PC customers in the next two to three years, according to a study by Future Computing Incorporated."

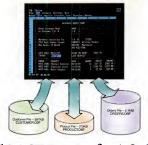
-Access 87 magazine (for Wang users), December 1987



"Relax, I'm only here for the clock-buttery."

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Witners this issue: Jonathan Matshit (Iaptop computer network cards), Kiw Gardner (Hewlett-Packard magazine), Charles Tuti (Ethernet coas), Philip Wagner (39-inch hard disks), Shannon Branjes (dots per nech), Scott Strehlow (RS-232 AC adapter), D. Daridovic (balk of PC entomers).



dBASE Power for 1-2-3

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Data Rased Advisor



BYTE Magazine

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"Using the benchmark timings published in BYTE, September 1987,

"Using the suite of benchmarks published in Data Based Advisor, March 1987.

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CRITICAL MASS



Products live and die in our marketplace on their own merits. Some, however, achieve critical mass and become self-sustaining. But what does it have to do with Henny Youngman?

dous 1-2-3, with a couple of million copies out there, has it. Even if the company went belly-up tomorrow, the 1-2-3 aftermarket, education, and support businesses would continue for years. That's critical mass.

XyWrite, with substantially less than a tenth of 1-2-3's sales, has it too, but for completely different reasons.

Critical mass is unimportant contpaced, with the quality of product product of a violation of the product product product product succeed over another. It's the measure not only of sales, but of support. Products without claim mass often wither and die, simply because they lack word of mouth and user buy lack word of mouth and user buy lack word of mouth and users with east of which will be support. The only thing wore, as Octaville Said, than being talked about in the being talked about and being talked about Likewise, there is virtually no such thing as bad publicity.

Those casual mentions keep up the retail demand for a product. They also give current users a sense that they haven't fallen behind the times or made a bad choice. After a while you get the idea that maybe you should have upgraded from EasyWriter 1.0 or dBASE II.

Critical mass is not an absolute number. Nor is it a straight percentage of market hame. It varies dramatically by the type of product. A new spreadsheet would have to have hundreds of thousands of copies in the field before it could be considered asnous challenge to 1-2-3. New products have a way of changing the ground rules, though. Microsoft Exect is less likely to grow at Lotus's expense than to attract new users who might have otherwise decamped. to the Macintosh market for the latest in windowing and graphics. Lucid 3D might replace 1-2-3 for some low-end, occasional users, but it is far more attractive to those who will appreciate its compact, pop-upnature and its nested, hierarchical structure. Laptop users are likely candidates for

Lucid.
Among databases, one way that products achieve critical mass is by doing certain things better than the market leader,
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and true to Newton's law, an object in motion tends to remain in motion.

Critical mass can be attained, even with very small numbers, by following a few time-tested rules.

KEEP CHANGING New versions are important. Nothing makes a user start looking around more than the sense that he's falling behind. Expanded features. greater speed, and add-on programs all contribute to the sense that a product is going somewhere. But wait, you might say. What about 1-2-3? With all the time it's been out there, it's still only had one major upgrade and two version changes. True, but that was in the face of almost no competition. Lotus's likeliest competitors. Multiplan and SuperCalc, are successful products but lack the magnetic appeal of 1-2-3. Multiplan never got the formula right, and by the time SuperCalc got it, the game was over.

KEFP CUSTOMERS HAPPY Active support is key to critical mass. Users who get answers give recommendations. Advice from knowledgeable or experience individuals remains the single most powerful marketing force. WordPerfect almost have any magical feature set that makes it better than other word processors. It have any the biggest 800-line operation in the soft-ware business, though. It's phenomenally expensive and just as successful.

USE THE USER User groups are like an extension of the customer service department. All it takes is a few members of

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a group to decide they have a common interest in a product, form a SIG (special interest group), and you're off. They provide support, training, program development, and beta testing-for free. Software manufacturers were, by and large, incredibly slow in discovering the power of user groups. Now they're catching on. They provide visits, demonstrations, materials, and direct support lines for special-interest-groups.

OPEN-ENDEDNESS One of the key elements in products that attain critical mass is programmability. When the manufacturer builds in a macro language or underlying programming language, the product is extendable; it rises above the static nature of its feature set. It also allows others to show how smart they are by adapting the package to a specific application. Kitbuilt applications are very much in keeping with the kit-built nature of the PC, where technically astute individuals do most of the preliminary work for end users. Indeed, configurability is what sets PCs apart from all the kinds of computing that have gone before. Programmability also gives the word-of-mouth brigade something to talk and argue about. I'm continually amazed by the sheer number of peonle who will submit themselves to the extraordinary effort required to learn a proprietary macro language and then say, "But I don't know how to program, when in fact they are creating entire applications within an application.

HENNY YOUNGMAN FACTOR Finally, software with critical mass is explainable as a one-liner, its purpose immediately apprehensible. 1-2-3 is an electronic spreadsheet. MathCAD is a computerized engineer's notebook.

Even if the one-liner defines a product's limitations, it still serves the basic purpose of clarification and communication. For instance, XvWrite is complex and command driven, but it's fast and great for indexes and tables of contents. Omnis Quartz is a network-hierarchical database that can be made to look relational but only runs in Windows.

You get the idea. These lines would bomb in a nightclub, but they're boffo in our marketplace.

Roger Staubach and Terry Bradshaw on Dac-Easy Light.



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Roger: Light gives me the option of handling accounting on a cash or accrual basis. Plus, if I forget any account or customer, I can quickly call it up in a window.

Terry: Well don't forget this, Roger. With Dac-Easy Light I can quickly set up new credit card accounts, post receipts, and keep tabs on current card balances. Plus, I don't have to know debits or credits because the system knows and automatically does them for me.

Roger: Terry, for once I think you're right. Light's so smooth and easy to handle, even you can use it.

Terry: And you're right, too, Rog. Using Light, you'll have more time to spend on the golf course. I just hope you're not trying to compete with my hall of fame game!

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THE BIG LIE



Did you ever wonder why UNIX, portable programs, and natural language interfaces are always being sold with such boundless enthusiasm?

There is always a motive to tell a lie.

It may be less painful than the truth.

It may be convenient. It may be
necessary for survival. To be effective at
selling an inferior for useless) product, one
must use lies but must be somehow convinced that the lies true. This kind of lie is
known as the big lie. It's the kind of lie that
governments use. It's the whongou. It's the

In the world of computers we see what appear to be a lot of false claims. In this industry the smallest and most insignificant false claim is treated by the perpetrator as a big lie. Let S face it, some people are sincere when they swear up and down that their spreadsheet is better than Loust 1-2-3. "If only we had more money to spend on marketing," Weyl Itel I you. Vesh. right.

UNIX AND OTHER LIES More interesting to me are those big lies that become institutionalized as one guy after another comes along to promote the idea. My favorite example is the notion that UNIX will not only achieve success as a personal computer operating system but will dominate the scene and be the operating system of choice. Every so often some salesman will convince himself that this is true and reestablish this notion in the public domain. It amuses me. Here's UNIX, the multitasking, multiuser operating system that's been around since the days of the Cro-Magnon, and its heyday is still expected. Folks, forget it.

Understanding the imagined appeal of UNIX helps us understand another institutionalized big lie: the notion that software portability is important. UNIX is praised for its portability more than anything. If something can be ported from one divergent system to another, this is somehow good, say the zombies.

Portrability. I know a company that makes a fairly deent telectory product, but their insistence that the thing be "as portale and a sealing be run off of a teletype. While his is fine if you need to mit off of a teletype, it handly appeals to the 80386 user with a VGA card. Users don't want portability. In fact, they could care less about it. Few IBM users ever use an Apple or a CPM clumker, so why would they care if a contrability in fact, they could care less about it of the work of the wor

SAY IT IN PLAIN ENGLISH? I suppose this all relates to some socialistic appeal to a sense of universality—the common user



interface that we'll never see. This thinking leads to another common big lie: the computer that understands ''plain English.'' I remember a minicomputer called the Adam that supposedly understood plain English. It didn'.

The funny thing about this notion is that users could really care less. Once people learn about computers they are happy as a clamto merely mouse-elick an icon or type "DIR" at the command line to get the directory. It is sure seasier than typing. "Mr. Computer, may I have the directory of any fliest." Or, even worse, saying something like that into a microphone. Still we recommend that the computer of the comp

The notion of the "understands plain English" computer has the same misguided nots as the "computer that never needs programming." The results of this thinking are program generators who you can speak to in plain English and who then crank out an elaborate program. Pearl was a very forgettable example of this type of thinking. Then there came Kany and the biggest fiase of them all, a product called The Last One.

Let's not even begin to talk about computer products sold as religion such as Valdocs or FORTH or the Macintosh. Life is tro short

The big question is, dear reader, can you spot the big lie when it comes your way—on some inevitable day in the future when a guy looks you in the eye and says, "It's the greatest!"



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INSIDE TRACK

Will Compaq license the MCA? Are computer viruses running amok? Will Sun emerge from its new dark cloud?

Tales of PS/2 and the Micro Channet. Look for Zenith and Compact for Channel. Insiders say they'll buy access to the technology. I BM has not comfirmed any deals. Details of the agreement aren't known, but it may cost both puter and echnology exchange contract that most of the mainframe builders had puter and echnology exchange contract that most of the mainframe builders had to do long aga. A typical arrangement or someone to use IBM's patients is 3 percent of the company's total revenue paid

It should be easy enough to build a PS/2 clone as Chips and Technologies makes the first clone chips available. Intel and a host of other VLSI specialists will follow.

Chips and Technologies recently bought Up-To-Date Technology of Sunnyvale in an interesting move to keep the market for its chips hot.

Up-to-Date is the outfit that did the popular Leading Edge machine and a few other designs for Samsung. Best known for quick turnarcund and good design. Much credit goes to design wiz Frank. Spahn, who, it seems, can design a clone in a day. With this group, C&T cann do a custom systems board design for a C&T customer during the time the chips are being developed, so chips and systems are being developed, so chips and systems are not seen early simul-

taneously.

The Consumer Electronics Show used to be a showcase for both crackpot and state-of-the-art technologies. Ever since the crash of the home computer business and decimation of the home game computer, the show has become conservative with emphasis on cam-corders and screwball phones. When high technology of the sort seen in years

past is shown, what we see is a grim reminder that the Japanese are embarrassing us arevery turn. My favorite example is a technology called EDTV (enhanced definition TV). While Americans are still arguing over what to do, the Japanese have already moved ahead. The results are a laugh rist. We are tending towards a wide-screen system with 420 by 201 lines of resolution. This compares to 330 lines of resolution in use today.

The EDTV image is beautiful, especially on the wide screen. But there are no plans to manufacture or broadcast with this technology. Government approval is needed. Committees are needed. Meanwhile in July, the Jananese are preparing to broadcast their version of EDTV. The equipment is already in production. Toshiba had a system at the show for display. It was also a widescreen TV with 1,000 by 720 lines of resolution! The company also had a 3-D TV that was flickerless and used the doublescan technology being broadcast in Japan already. We continue to argue in Congress about these things. We're still waiting for the aging digital audio tape debate to settle down.

The Japanese simply own the consumer electronics business. How long will it be before the personal computer market succumbs?

The irony of all this is that we see ourselves as the world's greatest businessmen. The notion even permeates the PC software development business. I don't know if you noticed, but there seems to be a boom in computer simulations of business situations, I've received five or six software packages in just the last couple of months. Each one was sold as a kind of game for the businessman and natterned after those borins science fistion simulations where the player is the ruler of some planet with limited resources, trying to keep the population from getting killed off.

I've seen them all and they're all boring. Attention vendors: we don't need another business simulation program. Send them all to Japan. We need all the belo we can set.

Virus Hysteria Dept.: Renember the essay I wrote about computer viruses: a few weeks ago? I may have been part of what appears to be some sort of virus mania. It really started to roll when the Associated Press (did a flaky news story about a virus supposedly planted in an Israell college and showing up everywhere. Not to be outdone. UPI did a quick story saying its reporters discovquick story saying its reporters discovduck story saying its reporters discovled to the story of the story of the Nobody was shown one line of virus control of the story of the story

Other Bad Trends Dept. The hot gossip in Silton Valley is about the recent purchase by AT&T of 15 percent of Sun Microsystems. Sun is working on what it internally calls a NeXT Miller—a machine designed to compute head-on with the new Steve 106s machine and the Macintooh II. If the new Sun machine is net with popular acceptance, AT&T is rumored to be willing to buy the rest of the company.

Sun specializes in UNIX workstations, something that AT&T the developer of UNIX) just can't seem to market. The company's last effort was the ill-fast ed model 7400. Meanwhile, the AT&T contract with Olivetti is up this year, and AT&T hopes to somehow use Sun as the maker of its next generation of deskton PC clones.

What this all means to me is that a lean and mean Sun Microsystems has let the camel of bureaucracy into its small tent. There are already rumors that AT&T paper-pushers are making "suggestions" to Sun about changing one thing or another. The end is near.



APPEALTO A HIGHER



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OS/2 APPLICATIONS PRICING: A GOUGE?



Users are prepared to pay higher prices for OS/2 application packages. In return, they expect vendors to offer enhanced functionality, better performance, and increased support.

ow that OS/2 has arrived, we're discovering some messy idee issues beyond the obvious "Do I oned it?" Version I.0, delivered by IBM in December and by other vendors over the first quarter, is mainly a product for programmers, a chance to see if they undersood what they were doing last year when they worked with Microsoft's \$3,000 OS/2 developer's kir.

But IBM has also announced an October delivery for OS/2, Version 1.1, with the Presentation Manager. Delivering Version 1.0 earlier than promised has given IBM's projected dates newfound credibility, so our attention moves now from "when" to "bow" and "why."

One little surprise lurking in the woods for early adopters of OS/2 is likely to be higher prices for OS/2 versions of familiar software

Software publishers are hardly united on this, but in general they plan to charge more for those OS/2 versions than for current (and probably, succeeding) DOS versions.

They argue that OS/2 products represent a new cost category for them (true) and deliver a new level of functionality (we hope). Thus they feel it's only fair to charge more for OS/2 products, and they feel we should be willing to pay more for them

I think they're right on both counts. But there's an argument the other way, too: It's a mistake to charge more for OS/2 products, and if software vendors want to retard OS/2's adoption, they could hardly do better than to price-discriminate be-

tween DOS and OS/2 versions—providing PC users with what economists call a

"negative incentive" to move to OS/2.

Let's look at both sides. And let's look at how 1,200 PC Magazine readers responded to a poll on higher prices for OS/2

application software.

COST AND FUNCTIONALITY The increased-costs argument is a fair one. The

creased-costs argument is a fair one. The R&D expense to develop a new OS/2 product is huge. "OS/2 isn't system software, it's a whole new culture," in the words of one programmer. Training programmers in OS/2, bring-

ing DOS programs over to OS/2 in ways that exploit OS/2's strengths, and ecocking upentirely new products native to OS/2 are all expensive undertakings. And they must be funded, remember, out of the revenue stream from DOS products—in other words, from what were once profits. That means developers are already taking a hit



on earnings, reinvesting in hope of a larger return downstream.

Logicians would tell us that's a "necessary but not sufficient" argument: true as far as it goes, but by itself not persuasive.

The increased functionality argument holds, too—but only to the extent that vendors really do deliver substantially enhanced functionality in their OS/2 products. Simple ports that bring DOS programs over to OS/2 but use only trivially the resources of the new operating system don't justify higher prices.

Certainly as OS/2 evolves—and makes more of its promise available to developers—we should expect to see ever richer and more-functional versions of OS/2 applications. But those early ports that simply allow users to run current DOS programs under OS/2 in native mode, rather than in the slower DOS "compatibility box"—what I've been calling "convenience releases"—shouldn't carry higher prices, either.

What do you think about this? I recently put a poll on the PC Magazine

Interactive Reader Service bulletin board, asking callers what they thought about higher prices for OS/2 application packages, Almost 1,200 of you responded.

More than 80 percent thought OS/2 applications would cost more than DOS applications. But 55 percent thought that was unreasonable.

When asked by how much you thought prices would increase, 38 percent thought the increase would be about 30 to 40 percent, 20 percent thought it would be 50 to 60 percent, and 15 percent expected to see

■ JIM SEYMOUR

prices go up just 10 to 20 percent. One reader in 12 thought prices would double. What do you expect for those prices? About 60 percent of you mentioned "more functionality," and 62 percent "higher

performance" (multiple answers were allowed). More than 22 percent expected "more support." About 11 percent—the cynics—thought there wouldn't be any changes, just higher prices.

■ I support vendors' plans for higher prices on OS/2 products, as long as they put more value in the box.

Readers also mentioned more userfriendliness in OS/2 applications, better follow-through on problems reported to vendors, better documentation and money-back guarantees.

Vendors, are you listening?

Your customers expect to be asked to bey more. A little more than half think that's unfair, but fair or not, a solid majority expect those higher prices to deliver better performance and more features. And they expect out op trovide better support in every way, and to acknowledge the act of faith customers are making in buying your OS/2 products by guaranteeing their satisfaction.

The importance of delivering more value—and of treating customers well as they move into OS/2—is underscored by the last question I asked readers: If your company expects to phase in OS/2 within the next 12 months, when will it be?

A solid 75 percent of readers responding said their companies wouldn't be changing (35 percent) or were still undecided (40 percent). Those numbers aren't surprising: few expect OS/2 to take off till we see those first dazzling, OS/2-only applications appear to drive that changeover.

But those numbers define an awfully fragile market, one attentive to every nuance of vendors' offerings and business practices.

PC users expect to pay more for OS/2, and in the main, they're willing to . . if they get more value, and if vendors treat their OS/2 customers a lot better, across the board, than they have treated their DOS customers.

As much as I hate paying more for anything, I support vendors' plans for higher prices on their OS/2 products. But only as long as they put a lot more value in the box, too

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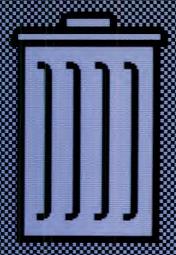
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Mail-order vendors get no respect. So why do so many customers—corporate and individual alike—prefer them to traditional "full-service" retailers?

It's 5:00 P.M. Friday. I'm about to put the finishing touches on a major quasidesktop-publishing project due dropdead first thing Monday morning. I decide to run a test or three to find out if what I see at least vaguely resembles what I'll get. As I can on the printer, its toner light goes on and stays lit.

Great. The printer is brand-new, so I have no idea what its warning really means. For all I know, it may be like my car's low-fuel light, which glares at me a quarter-tank and a hundred miles before emptiness. But it might work like the fuel gauge in my first car, whose E meant "Emergency: downhill travel only."

Sure, I can try and squeeze the 500 pages I need out of the toner I've got. But this isn't some rough draft. This will be final "almost-typeset" copy for reproduction. Snappy blacks are mandatory. Having the cartridge around is likely to maintain them and my sanity.

SURE, WE HAVE IT The printer, Okidata's Laserline model, is a loaner. I have no idea who in the tri-state area stocks it, let alone its consumables. I can just imagine what's likely to happen if I begin phoning computer stores:

"A tuna partridge for an Okie skater's razor clam? You'll have to talk to one of our salespeople."

Then 10 minutes on hold, after which the whole thing'll repeat with the salesman. Then da capo al fine with the manager, who'll tell me they don't have it.

Or he'll tell me they do have it. I'll spend an hour driving to the joint, finding a parking spot, and standing in line behind three customers waiting for the lone salesman to figure out how to install Paradox, after which he'll discover that although the cartridge is normally a stock item, it's not on the shelves tonight. Should be in any day now.

COMING THROUGH This is too horrible to contemplate. Fortunately, I remember seeing a PC Connection and for the printer. I dial an 800 number, and a courtecous, knowledgeable voice tells me the cartridges are in stock. I hesitate to ask—tistoow after 5:00—but I do anyway: Can one be delivered by air express tomorrow, Saturdav?

Thirty seconds later I have my answer: For a SS surcharge, Airborne will be at my door before the final credits roll on "Pee-Wee's Playhouse." I give my credit card number and address; at 10:00 sharp the next momine, the Airborne guv hands me



the carton. I've saved immeasurable grief and hassle, I know the cartridge didn't cost me top dollar, and I didn't even pay for the phone call.

This isn't the first time PC Connection has come through for me. A few years ago I desperately needed a fully populated AST RAMpage board first thing tomorrow, and they got it out with the same dispatch and alacrity. Not UPS, however: Its New York Christmas Holiday interpretation of "next-day delivery by 10:00" meant 10:00 P.M., and the delivery guy waltzed in at 9:30 at night. The PC Connection folks offered to hound UPS for a refund, and they did, even though it brought them not one cent-except in goodwill. I've heard similar stories and nary a word of criticism from dozens of other satisfied customers. Class is by no means absent in the mail-order business.

In fact, the worst thing about mail order may well be the term itself, with its implication that you might actually have to deal with the abysmal U.S. Postal Service. Typically the mails never get involved at all. The order goes by 800 number; payment is arranged via credit card; a private express service delivers the goods.

Mail order's biggest failing is supposed to be its lack of the service and support that retailers and other close-to-the-customer sources claim they provide. Maybe, In my experience, the wonderful, well-trained, highly experienced folks in retail circles tend to serve huge-quantity corporate accounts that word it stand for less. The bezos who mind the store for small-business and individual customers are novies whose

■ STEPHEN MANES

major training has been in how to sell whatever product comes with spiffs (a.k.a. "incentives," a.k.a. "push money") this week. The better mail-order houses know their products at least as well as most retail-

ers do-to the point of listing version numbers and compatibility considerations in the ads.

And mail order keeps retailers honest. Mail-order clones of standard cards-and

machines priced with razor-thin margins-help maintain a truly competitive market. Nationally published prices set an accessible standard, so buyers can readily determine just how much they're being asked to pay for all that service retailers supposedly provide. Will the \$200-plus premium the retailer demands for that software package really be worth it? Probably not-which is why so much software flies UPS or Federal Express.

For start-up companies with quirky products unlikely to survive in retail distribution, mail order is often the only answer. And mail order can often respond faster than retail. For many products, mail-order companies can ship large-quantity orders from their well-stocked warehouses while the retailer is still waiting for the goods to arrive.

PITFALLS Like any business, mail order does have its bad eggs. The worst recent case involved a slick operator who phonied up a credit rating to place ads in a bunch of computer magazines-not, we note proudly, this one. The ads offered industry-standard hardware and software at unbelievable discounts.

Those too-good-to-be-true prices were an instant tip-off that something was fishy. So was the rest: no 800 number, no credit cards accepted, cash up front required. Delivery? There wasn't any. Hundreds of suckers discovered the whole thing was a

scam Of course, the business of that "vendor" and others like him wasn't computers but fraud. Problems with real mail-order companies generally involve cash-flow crunches that occasionally end up in bankruptcies. Aside from getting personal recommendations before choosing a vendor, the best way to avoid getting stuck is to pay via credit card. If the goods don't show up. the issuer will reverse the charge. In most company-gone-sour situations, banks and suppliers rather than dissatisfied customers end up holding the bag.

Delivery delays are the other common complaint about mail-order houses-and retailers. Protect yourself by making sure the item you want is in stock; consider ordering elsewhere if it isn't. Few things in life are worth waiting for. Computer equipment is only rarely among them.



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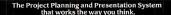
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& AUTOMOBILES:

12 Portables for the Road

ive years ago, portable computers were an exotic manifestation of gadget mania—the kind of hing you had to explain to people who saw you carrying one. No more. Use a laptop computer on most any arine flight and you won't hear a peep from your seatmates. Hile through any major airport and you'll see back-lit NEC ads with only the company's logo, a brief, untechnical slogan, and a picture of a NEC Mullisbeed nestled under a well-clad executive arm. Hop in a cab outside that airport, and on your ride into the city you're likely to spot a giant billboard displaying Toshiba's latest laptops. There's no all copy—just a big red Toshiba logo along the

Today's laptop and luggable computers have more speed, storage, and memory than ever.

•••••

top of the board. Laptops have made it to the mainstream.

What's more, portable computers have reached the same stage of maturity and acceptance as desktops did when the AT became commonplace. In fact, with one of the powerful new portables on your desk. you don't really need an AT. Several developments over the past year have brought portables and laptops a step closer to self-sufficiency.

FAST TIMES One of the best recent innovations in laptop technology is the appearance of more 286-based and, more exciting, 386-based portables.

Luggable 386s like the Compaq Portable 386 and the Dolch-Pack 386 reviewed in this issue maintain desktop compatibility by providing standard slots for add-in boards. The price you pay, in addition to the monetary punishment, is having to lug around a 20-pound-plus machine. But if you're not hung up on slots, you have an alternative: the GRiDCase 1530 is built around a 12.5-MHz 80386 processor, but it's no bigger than a Toshiba T3100.

The key to slimline 286 and 386 machines is CMOS (complementary metal oxide semiconductor) chips that pack more power onto a smaller chip, cutting power consumption and making battery-operated

OUR REVIEWERS

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Donald P. Willmott is an assistant editor of PC Magazine.

high-power machines possible.

We're seeing faster clock rates, too. Compag wins the speed test with its 20-MHz 386, but 9.54-MHz rates show up in several machines, and 8-MHz NEC V-20and V-30-powered machines are all over the place. That means faster processing for all your applications.

MEGA-MEMORY Portable computer manufacturers used to crow about their 640K-standard machines, and for many users 640K is still adequate. But if it isn't, take your pick from a dozen machines that offer memory expansion in megabyte-size chunks. Compaq allows up to 10MB in its 386 and so does Dolch; GRiD provides room for 8MB in the GRiDCase 1530. Toshiha adds RAM to its diminutive T1000 in the form of a battery-backed-up RAM card that slips into the machine and boosts its capacity from 512K to 1.2MB, with no noticeable gain in the machine's 6.3pound weight.

As for storage, early portables got by with floppy disk drives-after all, you weren't supposed to need Lotus 1-2-3 on the road; you were going to save that work for the office. As laptops move in on desktop territory, however, big disks are the order of the day. Ten- and 20MB hard disks are de rigueur on a serious laptop, and you can go higher if you want-up to 100MB in the high-end machines.

READABLE DISPLAYS The number of illegible laptop displays has become encouragingly small over the last year. Certain machines retain nonbacklit screens-the Toshiba T1000 for economy, the HP Portable Vectra CS for some unknown troglodytic reason-but the maiority of manufacturers have adopted one or another of the variations of backlit supertwist technology, resulting in brighter, clearer screens than ever.

This crop of portables also heralds the arrival of EGA in the laptop world. The Kaypro 2000 Plus is the first laptop to offer an EGA-resolution screen, and the result is promising. Sharper, denser characters that don't break up are a boon to people who've become accustomed to hi-res deskton monitors and groan at the spidery characters on many laptop screens. Datavue's announced but unreleased Smoke 386 puts the same kind of EGA screen in a lunchbox-style luggable, and others are sure to follow. The high end of display technology re-

mains gas plasma, as used by Compaq in its luggable and by Toshiba and GRiD in their deluxe lantops. The searing clarity of

We're still looking for a laptop with a fast processor, big disk, and great keyboard and screen in a package that weighs less than 10 pounds.

amber characters on a jet-black background is exemplified by the GRiDCase. whose blacker-than-black screen is a knockout for graphics and demos. But gas plasma takes its toll in power consumption, and though manufacturers say they're reducing power drain with proprietary display technology, gas plasma machines remain either AC-bound, like the Sharp and Compag, or fettered by dismally short battery lives-under an hour for the GRiD-Case 1530.

CONNECTIVITY A suboptimized display isn't the end of the world, however, Portable makers have gotten a lot better about allowing their machines to hook into the desktop environment. As a result, most laptops can power a CGA monitor, and many can drive EGAs, a good solution for easier personal viewing or group presentations. With keyboard extenders, expansion chassis, mouse ports, and bountiful I/O at your disposal, you can turn a laptop machine into a desktop powerhouse.

For now, most portables are excluded from the world of networking, but GRiD has shown that things don't have to be this way. With its 3270 emulation and Ethernet cartridges that slip into the back of its GRiDCase machines, you can bring your portable in from the cold, download field data into the network, pick up what you need from the server, and hit the trail again. It's a trend that will certainly gain

popularity as LAN fever spreads through corporate America.

SIZE SIGHS The trend toward smaller, lighter portables crawls along, but the editors who participated in this round of reviews agree that most of the machines are still too big and too heavy. With its 40MB disk, 386 processor, and gas plasma screen, the GRiDCase 1530 can get away with weighing 13 pounds, but we all agree that the 8088-based, LCD-equipped HP Portable Vectra can't. The Toshiba T1000 brings us closer to a competent bare-bones machine (see the accompanying sidebar "The Ouest for the 'Least Computer'"), but we're still looking for a laptop with a fast processor, big disk, and great keyboard and screen in a package that weighs less than 10 pounds.

We PC users are an unrelenting bunch; every breakthrough leaves us wanting more. Maybe 5 years from now we'll be complaining about "heavy" 5-pound portables that display only 64 colors. We sure hope so.—Nora Georgas

COMPAQ COMPUTER CORP.

Compaq Portable 386
Say what you like about other portables. The company that put a handle on MS-DOS has been out front for so long that evything else must be companed with its successes. And the Compaq Portable 386 is clearly one of its successes. Tim getting tired of saying the next line, but I'll say it again anyway, just for form:

Never before has so much computing power been available in so small a portable package.

No, it's not the smallest. It's not the lightest. And it certainly isn't the cheapest. It's just the best. "Best" is a lot coming from a guy who won't carry an MS-DOS portable because they're still too heavy. But if I go somephace to demonstrate some software, I don't want another machine. Just this one. And if I need to plug in PC-compatible boards and use 5%-inch floppy disks., I don't want another machine. Just this one.

You see, I've got my price, and my price is 20 MHz and 100MB. The Compaq Portable 386 dishes up performance that is bested only by its big brother, the Deskpro



A \$5,999, the Compay Parable 386 ian' far everyone, but with a 20-MHz 80386 processar, a 40MB hard disk, IMB RAM (expandable ta IOMB), a gas plasma display, and a full IBM Enhanced-asyle keybourd, this machine has more muscle than the systems in most offices, let alone hotel rooms. Many options are available ta enhance the system, including a IOMB hard disk priced at \$4,292.

386/20. It even beats IBM's Model 80. The Portable 386 began life as the Portable III with a 12-MHz 80286, when the standard was still 8 MHz. When Compaq's engineers put in an 80386, they skipped over 16 MHz and went right to 20.

In day-to-day use, the Portable 386 is pretty much a known quantity. All the latches, buttons, and movements that were so strange on the original Portable III are now familiar, and they've stood the test of time well. The keyboard has gained two more function keys, for the full IBM-compatible complement of 12.

SOFT TOUCH The battle rages on about the touch of Compaq keyboards, with dyed-in-the-wool IBM fans sorely missing the over-center click. Others love to use the word mushly. When you try this keyboard, you find that it has a light, sure

touch and you can type fast. I'm no fan of the new layout; I like the function keys at the side, not along the top. But that takes up space. Now that IBM has removed the incentive to have function keys at the side, we can pretty much look to keyboards like this as the future.

this as the future. The plasma screen, with its brilliant orange display, has improved somewhat a
over time, but it is still limited by a relative
inability to depict gray scales. The adjustment range is also narrow. Basically, using
time the control up all the way and ignore it
from then on. The display's saving grace is
is 640-by 400-pixel, tack-sharp resolument. Microsoff Windows 1360 fooks great
to the control up all the way and ignore it
terms. The display size is large enough for
three of four people to work controlly
around it, and there's enough tilt in the
mechanism that gate is never a problem.



Compaq is a big enough force in the marketplace that virtually any program you'd want to run in graphics mode has a driver for this screen.

Plasma technology is OK at the mundane job of emulating the bright-and-dim monochrome monitor, but it's not suited to the current VGA/MCGA state of the art, with up to 64 shades of gray. That'll be an interesting hurdle for Compaq, since it prides itself on being more IBM-compatible than IBM.

As with its 80286-based predecessor, the system bus is available via a small sliding door on the back of the machine. A \$199 piggyback unit holds up to two 8- or 16-bit expansion cards. You'll probably never need them. The machine has room for up to 10MB of on-board RAM, as well as a proprietary slot for Compaq's own 2,400-bit-per-second Hayes-compatible modem. In addition to the serial and parallel ports, there's a port for a CGA-compatible color monitor. About the only things you'd ever want to put in the piggyback are an EGA or VGA card or a connectivity board such as a 3270 adapter or LAN adapter.

Compaç has had one dominant theme ever since the first portable it shouldn't be a hassle to use. And the Portable 386 is just that: no hassle. Programs work the way you expect them to work. The floppy disk is a 1.2MB 5½-incher, and the optional 100MB hard disk is just plain amazing. With 100MB of sub-25-millisecond performance on tay, you can do just about any

kind of computing you want. If you need what this machine's got, the price doesn't matter.—Bill Machrone

DOLCH COMPUTER SYSTEMS Dolch-Pack 386

In every high school class, there's one hardworking, ordinary guy that nobody really notices. That is, no one notices him until he gets profited in the pages of Wall Street Journal as the head of a Fortune 500 conglomerate. On his quiet, steady way to the top, this guy would probably be using a machine like Dolch Computer Systems' Dolch-Pack 340.

The Dolch-Pack lacks the flashy reputation of some other "transportables," like the industry-leading Compaq Portable 386, but this machine delivers solid, near-state-of-the-art performance. And it does so for \$1,500 less than a similarly equipped Compaq machine.

The Dolch-Pack looks very much like Sharp's "lunchbox" portables because it is contained in an identical case. Its dimensions (9.5 by 16 by 7.8 inches) are virtually identical to those of the Compaq Portable 386, and it weighs a pound or two more than the Compaq, depending on options.

BIAZING SPEED Since the machine musis 80386 processor at 20 MHz, the Dolch-Pack delivers the kind of blazing speed that power users want, both on the desktop and on the go. Our processor speed benchmark test clocked the machine at 1.2 times the speed of a 16-MHz Compa Desktop 366. Among the laptops and portables we tested, the Dolch-Pack came in respectable second to the Compaq Portable 386, and it solidly outperformed to the processor of the compact power of the processor of the pr



Even though the Dokth-Pack 386 isn't nearly so well known as the Compaq Portable 386, its 20-MHz performance—along with the potential \$1,500 savings it represents over the Compaq machine—will attract buyers. The 23-pound Dolch-Pack has a backlit LCD screen and two standard-size expansion slots. Twenty- and 40MB hard disks are available.



Dolch-Pack 386 Dolch Computer Systems 20290 O'Toole Ave San Jose CA 95131 (408) 435-1881

List Price: With one 51/e-inch floppy dask. drive, 2MB RAM, \$4,995 In Short: Without the flashy reputation of some other "transportables," this portable nevertheless delivers solid, near-state-of-theart performance for less than a similarly equipped Compaq machine. It runs its 80380 processor at 20 MHz, delivering the kind of speed that power users want, both on the desktop and on the go 660 ALREA

mains unexplained: the first evaluation unit we tested had a Phoenix BIOS, but a second machine's BIOS hore the Ameri-

can Megatrends label. The 20MB hard disk supplied with both evaluation units showed an average access time of about 34 milliseconds when tested with our hard disk BIOS seek test

No one would seriously claim that the Dolch-Pack performs identically to the Compaq-vou do get what you pay for, after all. The differences simply boil down to getting along without some of the luxuries Compac devotees are accustomed to having.

First of all, the Dolch-Pack doesn't have the brilliant orange gas-plasma screen that makes using the Compaq so easy on the eyes. Instead, it has a blue, backlit supertwist LCD of the kind typically found on quality laptops. While it's not as crisp and bright as the Compaq's plasma screen, the Dolch-Pack's display is eminently readable. A button on the front of the case frees the screen to pivot in and out for the best viewing angle (though the screen on our evalution unit had a slight. annoying tendency not to stay where I positioned it).

Like all LCD screens of this type, the Dolch-Pack's display is best viewed headon. As you move off-axis, the image becomes very blurry, very fast. Simultaneous viewing by more than two people is difficult at best and makes you yearn for that sharp Compaq display.

FULL-SIZE SLOTS Of course, you can simply connect the Dolch-Pack to an outboard monitor, which brings us to one of the machine's greatest strengths; it accepts full-size, PC-compatible expansion cards. So if you use it at multiple sites where monitors are available, you can tote your PC's EGA card with you. For that matter, you can take along any other internal peripherals-modems, network cards, and so on-and save the expense of buying versions of all these devices just for your portable

In the configuration 1 tested, one slot was taken by a disk controller board, another was devoted to an EGA card, and a third contained a multifunction board. That left three slots (two 16-bit, fulllength, and one 8-bit, full-length) to user discretion.

The Dolch-Pack's keyboard is somewhat better than the average clone keyboard. The keys have no positive "click" response, but they offer a tad more resistance than is found on other non-IBM hoards. On the whole, I like the Dolch-

Pack's keyboard better than the much-maligned Compag's, but that definitely isn't saying much. One problem that could be easily corrected: the keyboard has a very short cord, which dictates that you sit very close to the machine.

The Dolch-Pack 386 is an attractive choice for anyone who wants the firebreathing power of a 20-MHz 80386 computer but who doesn't have a budget big enough for Compag's Portable 386. Fully loaded with a 40MB hard disk, the Com-

paq will set you back \$7,999. A similarly configured Dolch-Pack is still far from inexpensive at \$6,495, but the grand-and-ahalf difference is nothing to sneeze at. -Jonathan Matzkin

EPSON AMERICA INC. Epson Equity LT

In 1987, major hardware makers felt compelled to market three types of products in order to prove themselves full-service companies: a laser printer, an 80386-based computer, and a laptop machine. Tandy did it; so did HP. Of course, Epson already had a laser (not exactly a well-behaved



Epson Equity LT Erson America Inc. 2780 Lomita Blvd Torrance, CA 90505

List Price: With two floppy disk drives. 640K RAM, \$1,895; with 20MB hard disk, one flormy disk drive. \$7,995; supertwist LCD, \$300; backlit LCD, \$500 In Short: As a total machine, the Equity LT is worth less than the sum of its parts. The \$1,895 price tag quickly jumps to \$3,495 when you add a backlit screen and hard disk

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time next year. Which leaves the Epson Equity LT, the laptop portion of Epson's manifest destiny.

Like many products created more as building blocks than comerstones, the Epson is, well, suboptimized. It has some nice features, some annoying omissions, and a downright irritating Joe Isuzu marketing style, "Only \$1,895," the brochures blare. What you need here is a subtitle that says "Without Display or Hard Disk." "Only 11 Pounds!" says the spec sheet. Flash that subtitle again: "Without Display or Hard Disk." Add these two components, and your \$1,895, 11-pound machine becomes a \$3,495 14.2-pounder. That's hitting below the belt.

A FRIGHT FOR SORE EYES Unless you're the kind of person who talks to himself on the subway and is controlled by cranially embedded radios from God, you're going to need a screen on this thing. And unless you're both stingy and unconcerned about your eyesight, you're going to choose the \$500 backlit display, not the \$300 plain supertwist LCD. Epson's literature expounds endlessly on the merits of each display, claiming that the cheaper screen is better for daylight, while the backlit is perfect for using the computer in "dimly lit hotel rooms." Hey, that's not

what people do in dimly lit hotel rooms. Compulsive types can buy both screens and switch them around; the display is mounted on thick metal tabs that slide into columns coming up from the chassis. Swapping screens is pretty simple, al-



The Epson Equity LT is one of a group of laptops hovering around a \$3.500 price that include backlit screens and 20MB hard disks. Equity LT buyers can sure \$200 by selecting the nonbacklit LCD. The screens are easily interchangeable. Included with the 14-pound machine is Traveling Software's Luplink data transfer software.

though the early model we worked with is siff and requires a little brute force to attach the display properly. The backlit screen is bright, clear, and, yes, good for dimly lit hotel rooms, planes, and similar surroundings. But its characters are pale and spidery, harder to read than those of the sharper NEC MultiSpeed HD or Zenith Z-183.

Contrast and brightness controls on the front right panel of the display help a little. To save power, both screens shut off after 2 minutes of inactivity; you reilluminate them by hitting any key.

The 85-key keyboard is one of the nicer boards around. With ten function keys across the tor, separate numeric keyped, drives.

raised ridges on the home row keys, and Scroll, NumLock, and CapsLock LED indicators, it sensifices little in the way of full keyboard features. The feel is firm, and the keys are not cramped like the com-on-thecob keyboards of other laptops.

The speedy NEC V-30 CMOS microprocessor is switch-selectable to run at 4,77 or 10 MHz. The review unit came with 20MB internal hard disk (Order from JVC) that worked just fine. A switch on the back of the machine lets you turn off the disk to save power. I don't know why you'd consider nor getting the hard disk, but if you don't you can have the machine fitted with two 3½-inch microfloppy disk drives.

A 1,200-bit-per-second modem is also optional—though again, with a laptop, a modem isn't really an option, is it? Epson also throws in *PFS:Access* when you buy the modem.

Battery life is rated at 5 to 7 hours—we

A 1,200-bit-per-second modem is one Epson Equity LT option—though with a laptop, a modem isn't really an option, is it? Epson also throws in PFS: Access

when you buy the modem.

got it to run for 1 hour and 41 minutes with heavy disk access. The screen and hard disk shutoff and the CMOS processor probably help. The AC adapter is light and not too big. A removable battery pack like the ones GRiD and Tandy provide would be nice.

CHUNKY COMPANION So far, not bad, But let's get back to those numbers. Because this is where it's obvious that Epson is a general computer hardware maker, not a laptop computer ranker. The machine is just too bulky to be a comfortable traveling companion. It's unwieldy, its sharp-edged metal handle cuts into your hand mercilessly.

And those prices! If \$3,495 rings a bell, it should—that's about what you'd pay for a Toshiba T3100. It's also about what you'd pay for a comparable NEC Multi-Speed HD or Zenith Z-183 (and both have better displays).

If you buy the single-source philosophy so popular with hardware makers these days, and if you're wedded to Epson because of its Equity desktop line or for some astrologically advantageous reason, you can buy the Equity LT without fearing for your life (your knees, maybe, but not your life). Otherwise, walk on by.

-Nora Georgas

Imagine the speed and power of a \$100,000 minicomputer in a desktop PC cost ing under \$70,000. Now imagine all that power going to waste because the operating system you chose was never meant to take advantage of a computer this powerful. It will take more than just a "window environment" or an outdated operating system to unlock the \$80595.

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DISPLAYS: THE GOOD, THE BAD, AND THE UGLY



The Zenith Z 183's startling blue 6- by 8-inch screen still outshines the test of the backlit crowd.



The Kaypro 2000 Plus is the only laptop with an EGA display. For sharp, dense characters and graphics, it can't be beat.



The saturated black background of the GRiDCase 1530's gas plasma screen makes its amber text and graphics look razor-sharp.



The Compaq Portable 386's gas plasma screen has less contrast than the GRiDCase 1530's screen and yields a dimmer image.



Ah, compromise! The Toshiba T1000's 31/4- by 91/4-inch screen produces squashed images—OK for text, but not great for graphics.



The nonbacklit screen on the HP Portable Vectra CS's display stretches battery life but doesn't do much for eyestrain.

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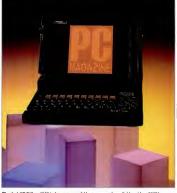
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GRID SYSTEMS CORP. GRIDCase 1530

There are portables, there are 386 portables, and there's GRiD Systems Corp.'s GRiDCase 1530. The first battery-operated 386 laptop, the GRiDCase reigns over this year's portable computer crop as one of the most-appealing, most-powerful laptops yet.

The Compaq and others offer 346 power to go, but they tether you to an AC plug, and they'd need to shed pounds and inches before they could be considered laptop machines. Not so the GRIDCase. The 346based 1530 weights under 13 pounds (even with a 40MB hard disk installed); it runs on a rechargeable, removable battery and can be purchased with a dazzling gas-plasma screen.

Our review unit was fitted with a 12.5-MHz 80386 processor, 40MB hard disk, and hi-res plasma display (there is also a transflective LCD screen and a 640 by 200 plasma screen). This system represents the top of the line of GRiD products, which span an impressive breadth of configurations and options. Not covered here, for example, is the newest version of the GRiDLite, which wasn't ready for review but should be available by the time you read this. Since our last review of the GRiDLite ("Road Warriors: 11 Laptops Battle It Out," PC Magazine, July 21, 1987), GRiD has improved the machine's screen and battery life and added more storage options. There's also the GRiD-



The sleek GRiDCase 1530 is the most powerful laptop currently available, with an 80386 processor running at 12.5 MHz. The magnesium case holds either a backlit supertwist LCD or a gas plasma screen, and hard disk from 10- to 40MB are available. The 13-pound laptop is not for the weak of wallet: a configured system can cost up to 57,000.



Fremont, CA 94537 (415) 656-4700 List Price: With two 3½-inch floppy disk drives, IMB RAM, \$4,695. In Shart: The GRIDCase 1530 is quite sim-

ply the most powerful laptop computer yet. Its 386 power is a little slower than that of the lunchbox 386s, but the 40MB hard disk is a top performer and the plasma screen is beau-

top performer and the plasma screen itiful.

Case EXP, an 80C86-based laptop with XT-compatible slots for expansion. And finally, there's the GRiDCase line, consisting of the 1530 and its 10-MHz 80286 twin, the GRiDCase 1520.

As the first laptop maker (remember the Compass?), GRID Systems established a reputation for providing rugged equipment for heavy on-the-road use. The GRIDCase tine continues that tradition. Its matteblack magnesium-alloy chassis feels more solid than any laptop we've seen. The machine has been "ruggedized" to withstand exruciatine heat, cold. humidity, vibra-

macho hype: GRiD sells only direct, concentrating on travel-intensive applications like sales, auditing, and field engineering.

ATTENTION-GETTER The machine is at once rugged and elegant. Walk invented and presentation with this under your arm—and you can, because though the GRID-Case is deep, it is well balanced and comfortable to carry—and watch the eyes wid—in. Unlike the gently sloping GRID-like, the GRID-Case is an 11½-by 15-inch rectagle that's less than 3 inches thick. When the deep screen flips up, obscuring the back of the machine, the machine looks

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The NEC MultiSpeed HD has a separate numeric keypad, large Enter key, and AT-style function keys.



The Epson Equity LT has full-size keys, a useful array of LED indicators, and speed switches under a flip-up panel.



Half-size function keys and an embedded numeric keypad are the price you have to pay for the true portability of the Toshiba T1000.



It looks a little odd, but the Kaypro 2000 Plus keyboard has a good feel and is detachable, though the cable is too short to be truly useful.



The sole weakness in a superb machine, the GRiDCase 1530 keyboard suffers from small keys and nonstandard key placement.



The Sharp PC-7221 has a full-size keyboard; there's no excuse for the size of its function keys or their illogical arrangement.

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even smaller and more compact.

The gas plasma screen has a blacker background than others we've seen. The characters are dense and sharp, and the resolution is great for graphics-intensive demos and presentations.

Storage options are many and varied.

The optimum configuration is one 40MB

The GRiDCase 1530

gas plasma display's characters are dense and sharp, and the resolution is great for graphics-intensive demos and presentations.

.......

hard drive and no floppy. A sleek black external 3½-inch floppy disk drive is available from GRID for \$350. Or, if you insist, you can have a single 1.4MB floppy and a 10MB hard disk, or two floppies, though Lord knows why you'd cripple this machine by denying it a big hard disk.

One of the GRUCese's unique features is its ability to integrate with LANs. With the 3270 emulation cartridge (\$495) slipped into the Ethernet cartridge (\$495) slipped into cartridge is at the back of the GRID-Cise, you can book into your company's LAN and the unit will behave just like any other node. (A further link to high-end desktop hardware is the GRIDCese is 5695 VGA monitor interface, which allows the Laptop to drive new graphics hardware.)

The same curtridge slot is home to the chargeable butter, which supplies about an hour and a half of power on the 40ME-and-disk, gas-plasm-screen model, and possibly more on models with less strensteines power requirements. To ma the machine on AC power, you care either slide in the AC power pack and plug in directly to the AC source, or plug in directly to the AC source, or plug in the battery pack and the AC pack, thus in charging the battery as you work. On AC power the GRBD runs rather box—moordreably hot if it's in

your lap. But this is probably a nonissue, since if you're running off AC you'll probably have the machine on a desk or table anyway.

If the GRIJCRase has a flaw, it's the keyboard. The Z-key layout includes fullsize AT-style function keys across the top, but there's no separate numeric keypad, CapsLock, NumLock, or ScrollLock LED indicators are about, and the Return key should be bigger. The tightly packed keys seem small, and the whole keyboard is flat, which locks great and complements the rest of the design but is hard to get used to. For a better typing angle, you can fold the handle down and see it to raise the back

end of the macnine. But GRID's intended users—salespeople, accountants, and engineers, accountants, and engineers aren't likely to need a keyboard optimized for touch typing. Still, the GRID-Case keyboard will have to be modified before the machine gains popularity in the mariseral laptop world dominated by To-street laptop world dominated by To-boards. But the machine gains product that all of whome products have full-size, desktop-style key-boards.

BUILT FOR SPEED Hitting the Backspace key a lot is a small price to pay for running 386 applications in your lap, miles from any wall plug. Lotus 1-2-3 or your favorite word processor flies across the screen, making it difficult to migrate back to a lowly deskbound AT. The standard IMB RAM gives you room for most demanding programs, and you can boost memory in 2MB increments, up to 8MB. The machine is also EMS compatible. And, as with previous GRiD models, there is support for user-installable ROMs (GRiD Systems will even burn in ROMs with your company's customized software). Two ROM slots totaling 512K are hidden under a slim panel at the top of the keyboard.

Powerful, beautiful, fast, and expandable—this machine really has it all. Of course, none of these attributes comes cheap; you'll pay over 57,000 for a fully loaded GRIDCase 1530. But it's more powerful than the machine you have on your desk right now. In fact, with the GRIDCase 1530 under your arm, you might not even need a machine on your desk—Nors Greenas

HEWLETT-PACKARD HP Portable Vectra CS

The 18-pound-plus HP Portable Vectra CS looks like a throwback to those haleyon days when women wore bouffants and giant Packards and Buicks ruled the roads—or to the days of the original Compaq Portable, when 35 pounds seemed a small burden to bear in exchange for true PC power.

Those days, of course, are long and thankfully gone, and those computers that still weigh us down also provide great power, as did the gas-guzzling cloudmobiles of the fabulous forties and fifties. Machines like the Compaq Portable 386 and the Dolch-Pack 386 weigh more than 20 pounds, but their burdensome packages are tightly wrapped around wanton 16-MHz speed and crisp electroluminescent readability. The Vectra CS provides neither the power of these beasts nor the sleek portability of econoboxes like Toshiba's T1000. While up-to-date and sometimes innovative features dot its fact sheet, the CS is, in general, the most depressing kind of anachronism: the kind that reminds you that the good old days also contained their share of hardships.

A DIM VIEW For instance, remember the difficult-to-read liquid-crystal display of the original Data General One? The HP's screen will not line the pockets of nearly as many ophitalmologists as that myopia inducer did, but by today's bright laptop standards, reading it is no pleasure.



Hewker-Packard 19091 Pruncridge Ave, Cupertino, CA 95014 (800) 367-4772 List Price: With two 3½-inch floppy dish drives, 640K RAM, S2, 495 In Short: The Portable Vectra CS is coni-

In Short: The Pontable Vectra CS is equivalent in price to other 20MB-hard-disk laptops, but it weighs up to 6 pounds more and is bigger by several inches in every direction.

Its design represents two grant steps backward GROLE 677 ON READER SERVICE CARD

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IT'S THE LITTLE THINGS THAT COUNT



Removable, rechargeable batteries enhance the Toshiba T1200's mobility and ease of use. Tested battery life was 2 hours and 7 minutes of operation.



Busy but useful, the Sharp PC-7221's control panel puts all the necessary adjustments and indicators within easy reach.



A clever LCD gauge above the HP Portable Vectra CS's keyboard displays the percentage of battery power remaining.



Like the HP Portable Vectra CS, the Kaypro 2000 Plus includes a small battery-life gauge next to its power switch.



GRiDCase designers showed good sense in numbering the ports on the back of the GRiDCase 1530 and silk-screening a legend ents the hendle



You can stuff up to 8MB RAM into the handy slot above the GRiDCase 1530's keyboard. User-installable ROM is an option too.



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The best word to describe the HP Partable Verta CS is large. The clamshell-style laptop measures 16½ by 14 inches and weighs over 18 pounds. Two microfloppy disk drives are standard; one can be replaced with a 20MB hard disk for an additional \$1,100. The readability of the nonbacklis LCD acreen was rated as fair, but the battery life—over 6½ hours—was the longest among all the laptops tested.

The contrast isn't bad—as long as ambient lighting is perfect and you're looking at text rather than graphics.

uck tainer man grapuses.

In CGA mode, on-screen images wash
out like bleached rags, while the flicker
produces a sensition similar to being
tossed on rough seas in a small vessel. No
backlighting or electrolluminescent option
is available. Two saving graces: (1) you
can continuously adjust the display's
viewing angle so that if there is a decent
ight source, you should be able to reflect it
adequately; (2) the screen is easily
catched, and a CGAEGAMDA-compatitached, and a CGAEGAMDA-compati-

ble output protrudes from the machine's rear.

The keyboard smacks of refreshing modernity. It is a full IBM-style layout with a pleasant if somewhat insubstantial feel. Its main problem is that the keys are polished too smoothly, making them slick to the touch. They are also angled too steeply for my Big Blue-influenced taste.

The 12 function keys lie in a little trough that separates the number keys and the pop-up floppy drives, making them awkward to reach, especially in single-handed combination with the Ctrl and Alt

keys. Spreadsheet users will be pleased by the separate numeric keypad.

ABUNDAYI POWER Our evaluation unit was a two-floppy model, instead of the more desirable 20-MB-hard-disk version (the Vetera CS 20). These are handy floppers, though: 1.44MB 37-sinch drivers on the vetera control of the vetera desirable size of the veteral desirable size of the veter

Battery power is abundant. HP claims a 10-bun life for the lead-acid power plant inside the CS; while no two applications are the same, use and testing showed this to be a reasonable average estimate. It certainly had the longest tested life of the nine battery-operated laptops in this roundup. The battery itself is easily removable

and recharges overnight. And the neatest gizmo on the machine is the cute little LCD battery-life indicator that sits in its own 4- by 6-inch plastic wasteland above the numeric keypad. Not only does it tell you what percent of the battery's juice remains, it is also much more readable than the CS's output display.

Under the hood lurk two 60-pin edge connectors, for adding on up to 6MB RAM past the CS's standard 640K. Other paradhability includes a choice of 1,200-or 2,400-bit-per-second moderns. Annoyingly, you can get either the aforementoned multiple-output display card or a parallel printer port—but not both togeth-output display card or a parallel printer port—but not both togeth-odd by the control of the properties of the prope

MORE MYSTERIES Something else that falls into the category of "unfathornable features" is the inscrutable on/off switch. I've wrestled with dozens of different laptops and never had the slightest difficulty finding the switch that makes them so. Until this one. Upon first luepine.



The computer world is humming about two new Samsung Semiconductor & Telecommunications (SST) brilliant performers — the S500 and S300.

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drive comes standard and a hard disk can be added for ample memory capacity.

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■ PORTABLES

the CS across my threshold and opening it up, I found myself immersed in a futile 30-minute search, into which I enlisted my computer-naive roomate and her friend, for a way to power it up. Finally, I called had been experience and had called a friendly HP dealer in order to make the admend thing work. We have to live with our shame, but just so that you are never similarly embrased, it's that little thing that looks just like the display's contrast side in the growce to the right of the key-

My biggest complaint about this machine is that if fills no conceivable portable computer niche. Its size and weight make prolonged laphog use an endurance exercise, while its price/performance ratio makes in either a low-cost nor a high-power option. Its pop-out handle is not knot or padded, and no shoulder-starp cardiocomplaints of the proposed of the road, and its poor graphics make this a bad demonstration/psecnation machine.

Only the sales figures will tell if the Portable Vectra CS is, as HP representatives insist their market research shows. what the portable market wants. My guess is that a few corporate buyers will be more lulled by the sirens of Hewlett-Packard's direct-sales force than by the superior features and portability of other machines. But who knows? Perhaps there is a market out there for a huge 161/2- by 14- by 31/2inch, 19-pound, 7.16-MHz portable with a decent keyboard and below-average display. Maybe the nostalgia factor will kick in. Some of those old Packards are much in demand these days, and even bigger, older Duesenbergs regularly go for over a million bucks at auction.-Paul Stafford

KAYPRO CORP. Kaypro 2000 Plus

Those who remember Kaypro's first portable computer will agree that the company's products are a little offbeat. The Kaypro 2000's royal blue metal housing was boxy, all sharp angles and corners, like a cross between an oscilloscope and a TV set. Nevertheless, it was a great machine for its time, and it started many PC users down



The \$2,795 Kaypro 2000 Plus is one of two laptops in this group that come in a metal case. One result is extra ruggedness; another is bulk, almost 16 pounds' worth. The unit measures 11½ by 13 inches. Standard equipment includes two microfloppy disk drives, 768K RAM, a NEC V-20 processor, and EGA resolution—an unusual feature in a laptop.

the portable computing road.

Years later, we have the Kaypro 2000 Plus, the direct descendant of Darth Vader's funchbox. The body is still aluminum, but the sewing machine-style case has given way to a clamshell design, and the screen incorporates advances in display technology. So in some ways, at

least, Kayymo has conformed. But the 2000 Plus has its share of quirks. One of the most intriguing is its keyboard, al 2-by 5-tich metal-and-plastic affair that either snuggles into its compartment and lies has with the machine's control panel or detaches to go closer to the screen. Small, spindly legs resembling a lunar landing apparatus can be flipped down from the bottom of the keyboard to provide a tilted surface for typing. The mystery here is the 6-inch cord, which

doesn't allow much room for movement. It's impossible, for example, to sit with the



Kaypro 2000 Plus Kaypro Corp 533 Stevens Ave. Solana Beach, CA 92075 (800) 4-KAYPRO

List Price: With two 3½-inch disk drives, 768K RAM, \$2,795. In Short: This relatively no-frills traveling

machine offers no-nonvense styling and a reasonable price, but it is not without as quarks. Well-spaced keys, high screen resolution, and a broad complement of software (including WordStar 2000) add to its appeal CHECK TRECOMPLICATION COMP.

LAPTOPS ON THE CUTTING EDGE

In order to keep its piece of a rapidly expanding but still relatively small market, a laptop manufacturer must constantly be prepared to update its current machines as well as introduce new ones that answer the many demands of laptop issers.

The first quarter of 1988 has seen a flurry of new laptops and laptop upgrades either announced or shipped. Here's a quick report on some of the machines not available in time for comprehensive evaluation in this review.

Amstrad has introduced a low-end. 8086-based portable with a built-in 2,400-bit-per-second modem and a \$999 price tag. The PPC 640 has 640K RAM. a supertwist LCD screen, and one 31/2inch floopy disk drive. A dual-drive version sells for \$1,099. Weighing in at 11% pounds, the PPC 640 also includes parallel and serial ports and DOS 3.3, It has a top clock speed of 8 MHz. The machine is unusually wide and shallow and is carried with a handle located in the right side of the unit. The screen folds down into the back of the two-part, hinged machine, and the keyboard then folds over the top. Contact Amstrad Inc. at 1915 Westridge Dr., Irving, TX 75038-(214) 518-0668

Data General Corp. has announced a 20MB hard disk and a har code reader for its DG/One Model 2T laptop. The 20MB system will sell for \$3,095, and the 10MB version has been reduced from \$2,895 to \$2,695. The bar code reader is priced at \$735. Contact Data General at 4400 Computer Dr., Westboro, MA 01580: (617) 366-8911.

Datavue has improved the Snap 1+1 laptop by hiking its top processing speed to 9.54 MHz from 4.77 MHz. The speedier version, complete with 20MB hard disk, has a list price of \$3,495. Slower Snaps are still available at slightly lower prices.

Datavue has also announced the Smoke386, a 20-MHz, 80386-based portable that uses a unique square, black-



The \$6,499 Toshiba T\$100 is based on a powerful 16-MHz microprocessor.



Remote Equipment's Remote Spirit 286 is an 18-pound AT-class laptop.

on-white display with 640 by 480 resolution. The lunchbox-style machine has several disk drive configurations, including a 40MB tand disk version with 33%-inch and 53%-inch floopy disk drives. The 16%-pound machine will ask one an optional expansion box that will ascommodate two flut-size XT or Are pansion cards. Pricing has yet to be determined. Contact Datavous at One Ways, Norcross, GA 30093; (404) 564-555.

NEC Information Systems has begun shipping the APC IV PowerMate Portable, an 80286-based lunchbox machine with 640K RAM and a 20MB hard disk. The \$3,995 unit, which runs at a top speed of 10 MHz, includes two available full-size, AT-style expansion slots and a backlit LCD screen that supports both COA and EOA graphics resolution; other displays can be used via the built-in RCD interface. A 40MB hand disk version is also available. Contact NEC Information \$5,954 unit AT-14 Massachusetts Ave., Boxborough, MA 01719; (617) 264-8000.

The newest lastop competitor from the Grand White North is Montreal-based Ogivar Technologies' System IV, an Aconjs 8028-based lastop with 20MB hard disk and EGA-compatible gas plasmar than the State of lastop of the State of lastop on the State of lastop options. Contact Ogivar Technologies at 2200 Trans Canada High-nologies at 200 Trans Canada High-nologies at 200

crops, is offering the Remote Equipment Cops, is offering the Remote Spirit 286, a 12-MHz 80286-based laptop that includes 640K RAM, a bulli-in dot matrix printer, and a 20MB hard disk. The 18pound machine also features a backlit LCD and a full-size 102-key keyboard. Pricing has yet to be determined. Contact Remote Equipment Corp. at 2502 Rossevelt Ave., Indianapolis, IN 46218; (317) 637-4481.

Korean giant Samsung has brought out an entire line of laptops, the star of which is the S6100, a 16-MHz, 80386based laptop with gas plasma display and an internal 20MB hard disk. Also standard are 2MB RAM and parallel and serial ports. Its weight is approximately 11 pounds.

The SS100 is a 10-MHz AT-compatible machine housed in the same box as the S6100. Like its more powerful sibling, it includes a gas plasma display and a 20MB hard disk. 1MB of RAM is standard, and its weight is also 11 pounds.

ard, and its weight is also 11 pounds. Neither the S6100 nor the S5100 is battery powered, nor is the smaller 10-MHz S5000. This machine, which includes 1MB RAM and a 20MB hard disk, has a backlit supertwist LCD screen. Pricing for all three models has yet to be determined. Contact Samsung at 2952 Bunker Hill Lane, Santa Clara, CA 95054; (408) 988-2376.

Toshiba America is adding power to the high end of its laptop line with the introduction of the T3200 and the T5100. The T3200, priced at \$5.499, is built around a 12-MHz 80286 processor and comes standard with a 40MB hard disk. Similar in appearance to the T3100, the T3200 has two internal expansion slots—one full-length 16-bit and one half-lensth 8-bit slot.

The 15-pound T\$100 is based on the 16-MHz 80386 processor and comes standard with a 40MB hard disk and the same gas plasma screen as the T\$100 line. The \$6.499 price also includes 2MB RAM. Contact Toshiba America Inc. at 9740 Irvine Blvd., Irvine, CA 92718: (714) 380-3000.

Victor Technologies VP286 is the first lapopt to 6fre a 30MB inernal hard disk as well as a 30MB removable hard disk. Based on a 10-MHz 80286 processor, the 18-pound unit features the ADD-PAK, a self-contained half-height 39/-sinch hard disk drive that sildes into the side of the machine. Information stored or transferred onto the ADD-PAK can be easily moved to any Victor VPC desktop machine that shares the feature. Pricing to 45 ms 45 ms

Finally, British high-technology gumextraordinaries for Cit'es Sinclain has been showing the 1-pound 14-ounce Z88, a tiny Z80-CMOS-based unit with 32K. RAM and a supertwist LCD screen with an 8-line by 106-character field. The Z88, priced at 499, has an S8-232 port and runs on four AA batteries for up to 20 bours—Donald P. Willmott. computer on a desk and the keyboard on

your lap.

The keyboard makes up for its oddness by providing a layout and feel that are as good as those of any boards we tested. The large keys are comfortably spaced and have good audible and tactile feedback. The black letters on white keys are especially easy to deal with in dim lighting where the gray keys on other machines force you to squint.

There's no separate numeric keypad, and cursor movement keys are arranged in an inverted T formation instead of a cross. But the return key is large and L-shaped, and the insert and delete keys are easy to find. Ten full-size function keys stretch across the top of the alpha keyboard. There are no LEDs to indicate NumLock, Scroll-Lock, and CapsLock or tell you which drive is in use.

MORE UNIQUE FEATURES Kaypro also vecred away from the mainstream in scheder of display—again with mixed results. As far as we know, the 2000 Plin know state, and the provide market. (Datava's Sabbased Smake also has an EGA screen, but as of this writing the machine is still plagued with problems and is not yet shipping. The 2000 Plins uses a new Jamping. The 2000

In a well-lit room, the display is very high but seems to lack contrast. Turn down the lights, and the screen becomes a gern. Regardless of the lighting, however, you notice the higher resolution immediately. The characters are dense and solid with more of the spidery, fragmented look you get on other portable LCD screens. The overall effect makes the display much caseir on the eyes than even the brilliant and NEC MultiSpeed HD.

The machine apneass well constructed.

although certain details, including the handle, are flimsy. Rubber pads on the bottom of the machine (and the power pack) prevent things from sliding around on desktops and other smooth surfaces, and a wide-ribbed band of rubber wrapped around the edges of the body acts as both a bumper and a decorative clement. Ports are cleverly concealed behind flip-up panels under the disk drives. A simple battery gauge sits between the power switch and the contrast control above the keyboard.

The Kaypro 2000 Plus cones with an unusually broad complement of software. In addition to DOS 3.2 and GW-BASIC, you get Workfare 2000 and the Work Finder thesauns. Workfare rayon to the your ideal in Why software, but at least Kaypro is trying; this is the only machine reviewed here that's bundled with a WP package. It's also the only one that comes with a 1.200-bps model mas standard equipment. Affith piece of software, Mirror II, is provided to run the models.

The 2000 Plus sports two 760K 3½inch floppy disk drives, mounted on either side of the machine; no hard drive is available. The NEC V-20 processor performed on a par with other portables using the same chip.

This machine has a Spartan appeal. Its no-nosense styling and reasonable price (\$2,795) should commend it to people who want a no-frills traveling machine that will get the job done with a minimum of fuss.—Nora Georgas

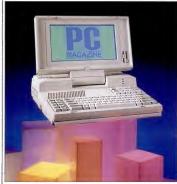
NEC HOME ELECTRONICS (USA) INC.

NEC MultiSpeed HD

I admit it. Ever since I saw the first fullsize, eye-popping, backlit shocker of a screen on the Z-183, I've been a diehard Zenith fan. But NEC's sizzling new laptop may just wean me away.

The HD is a much-improved version of NEC's earlier twin-diskette MultiSpeed, with a 20MB hard disk purring inside. It sports a bright new backlit screen that's larger than most of the others that we've tested and is virtually as crisp and readable as the Zenith standard. And it packs a with the control of the control of

But what really sets the MultiSpeed apart from the recent crop of look-alike laptops is its unparalleled 85-key keyboard, with two columns of full-size function keys in their proper place at the left edge of the machine and a dedicated number/cursor pad in the upper-right-hand cor-



Among the crowd of hard disk laptops for around \$3,500, the 14-pound NEC MultiSpeed HD stands on for its excellent keyboard and legible backlit supertwist LCD screen. The MultiSpeed, which has a NEC V-30 processor running at a top speed of 9.54 MHz, includes a 20MB hard disk in its \$3,695 price. Battery life with moderate disk access was logged at 1 hour 55 minutes.

ner. Some of the keys on the older diskette version were too small or in the wrong location, but the HD answers every objection. The F and J keys are scooped out to make your fingers feel at home. Bright red shift-state LEDs are impossible to ignore. The key action is better than average.

My only cavil is that the keys are a little slippery and don't give quite as much tactile feedback as they should. But after fighting with the skimpy keyboards and bizarre layouts on most other systems, I found this one a genuine pleasure.

NEC also fixed its screen-locking mechanism and redid the swoopy, toylike styling of the earlier diskette-based version. The new HD looks dense, solid (it should be, at over 14 pounds), and businesslike. Two things that NEC didn't repair, unfortunately, are the overly wobbly handle and the fanglike cover-locking flanges that seem destined to snap off, given the abuse that most traveling machines take. NEC also neglected to cover the ports at the rear of the machine, which means that if you're using the system on the road, they pick up grime from lots of exotic

EXTRA BAGGAGE With every system you get 512K of ROM-based pop-ups that you'll truly never use (a file manager complete with report writer, a notepad and spelling checker, outliner, communications manager, dialer, and setup program—but still no calculator). The first



thing virtually all buyers of portable computers do is copy their favorite desktop software into the road machine. They purchase laptops so they can take their familiar systems with them when they travel. Nobody wants to learn two different sets of programs that do essentially the same thing.

The only really useful aspects of the HD's firmware are a decent interface that turns the laptop into a remote disk drive for dealing data transfer, and a series of tersabut tip-filled help screens that are handy for about the first 2 hours after you snap the thing on. And the setup program isn't bad.

Also standard are parallel, serial, RCIB, and external Toppy portions, a real-time clock, and 640K or RAM—128K or which is static memory ownered by a separate nickel cadmium battery that keeps the internal phone directory, clock/calendar, and hardware configuration alive and ticking, and can double as a nonvolatile RAM-disk. And, of course, there's plendisk. And, of course, there's plendisk. And of course, there's persecond modern

As with most systems today, you can turn of jisat about everything under the hood to save power. A complex warning system alerts you when the batteries ebb, although the HD won't mind if you accidentally shut the cover without first turning in off. One safety feature is welcome: since you can freeze a foreground application unseen when you pop up one of the HD's built-in firmware programs, if you try to shut the completer off while your original

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Funk Software, 222 Third Street, Cambridge, MA 02142 © 1987 Funk Software. The Worksheet Utilities is a trademark of Funk Software. application is still running, it will put up a struggle.

Still, if you don't mind shouldering the load, this power-packed portable has everything you'll need to take your office with you. Its vivid, eminently readable screen, clean no-nonsense styling, jet-propelled performance, and near-perfect keyboard edge it to the top of the heavyweight class.—Paul Somerson

SHARP ELECTRONICS CORP.

Sharp PC-4521

When I opened the lid on the Sharp PC-4521, I had high expectations. Sharp Electronics Corp.'s top-of-the-line laptop runs at 7.16 MHz and has an internal 20MB hard disk, an illuminated supertwist LCD, and a full-featured keyboard.

But the PC-4521 proves that high expectations all too often lead to disappointment. The odd mix of high-performance features and uncomfortable design makes me feel that the engineers looked at the blueprints but never used the computer.

Unlike those of many other laptop comtor, the PC-4521's keyboard manages to provide real functionality by designing room for an oversized Enter key and a separate, normal-sized numeric keypad. The layout pretty much matches that of a stan-



The Sharp PC-4521 has many of the same components as other laptops (2004) hard disk, backtil supernists LCD screen, 640K RAM), but for several hundred dollars less. Those features are all included in the \$2,995 price, as Is an 80C86 processor running at a top speed of 9.54 MHz. The case measures 121/4 by 131/4 inches.

FACT FILE Sharp PC-4521 Sharp Electronics Corp. Sharp Plaza Mahwah, NJ 07430 (800) BE-SHARP List Price: With one 31/2-inch floppy disk drive, 20MB hard disk, 640K RAM, \$2,995; serial interface card, \$99, Model PC-4501 with one 3½-inch floppy disk drive, 256K RAM, \$995; 640K RAM upgrade, \$177. Model PC-4502 with two 3½-inch floops disk drives, 640K RAM, \$1,795. In Short: The price tag alone demands that anyone in the market for portable performance check out the Sharp PC-4521. This lanton computer doesn't compromise on fea tures, but with stiff keyboard response and a less-than-optimal screen, a does compromise

dard keyboard. And although the cursor control keys have moved down to the low-er-right-hand corner, they're perfectly us-

The trouble, as always, lies with the function keys. F1 through F10 are arranged in a double horizontal row along the upper-left portion of the keyboard panel. Maybe IBM can get away with this kind of inconsistency, but Sharp should certainly think twice before inconveniencing its customers.

The keyboard's tactile response is stiff—after about 30 minutes of typing, my pinkies protested and went on strike. I also found it helpful to turn off the artificial key-click sounds; they seemed slightly out of sync with my keystrokes and caused a

weird audio parallax effect.

The keyboard has handy status lights for power on, low battery, and floppy-ver-

sus hard-disk access. The low-battery light is accompanied by a discreet beep. There are no provisions for plugging in a full-size desktop keyboard, but if Sharp would only fix the position of the function keys and the key resistance, you wouldn't need one.

MONITOR CONTROL If you intend to use this computer for long periods of time, you may want to consider plugging in a desktop monitor. The Sharp illuminated supertwist LCD promises easy viewing, but the contrast range is limited and especially difficult to adjust in bright light.

Siting squarely in the average category, the PC-4521's display just isn't good enough for desktop use. Luckily, the company manufactures a controller card for either a color or a monochrome CRT. The

proprietary card is available for \$255.

The display is CGA compatible and has

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My current Sideways p	rogram disk is enclosed.	
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Portable Computers: Summary of Features (Products listed in ascending price order)

Techilo T1800 S1:199 BOCSS (4:77 Met) Supertwist LCD 6:31 S12K 1:2MB One 310-lach Bappy disk drive	Epson Equity LT \$1,995 MCC V-30 (4,777/0 Mints) Superhalet LCD, \$300; bastel, \$500 14,26 640K 640K	HP Pertable Vectra CS \$2.495 NECV-30 (4.777/16 Selt) Superfunet LCO 18.34	Keypro 2000 Plas \$2,795 NEC V-20 (4.77:8 Metr) Backing superhest LCD 15.88	Sharp PC-4521 \$2,995 NEC V-30-consprible (4 77/716 Metz) Backin supertwist LCD 12.77
\$1,199 9008 (4.77 Mtg) Supertwist LCD 6.31 512K 1,2MB	\$1,695 NECV-30 (4.7770 Mintr) Sepertment LCD, \$300; becklit, \$500 14.26 640K 640K	\$2,495 NEC V-39 (4.77716 MHz) Superhwat LC0 18.34 640K 6MB	\$2,795 NEC V-20 (4.77% Metr) Backin superhrist LCD 15.88	\$2,995 NEC V-30-compatible (4 77/716 MHz) Backlnt supertwist LCD
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1.2MB	640K	6MB	768K	
1.2MB	640K	6MB	768K	
One Wellarth				640K
One Woulant	0		768K	1.6MB
One 310-inch Boppy disk drive			•	•
One 310-Inch Bappy disk drive				
Hoppy disk drive	Two 31/2-inch	Two 3/d-unch	Two 30t-unch	One 310-rach
	Roppy disk drives	Happy disk drives	Reppy disk drives	Roppy disk drive. 20MB hard disk
None	20MB (\$1,100)	20MB (\$1,100)	None	None
External 514-inch	None	None	External 5 /4-mch	External 514-inch, 5499
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		**		
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\$20	\$29	None	None	\$30
RGB	RGB	RGB, EGA, composite	RGB, EGA, composita	Optional RGB and composite, \$255
•	•	•	•	0
•	•	•	•	•
None	1			1
None	None	None	None	4 slots, \$699
SideKick	DOS 3 2, Lapliek	None	ODS 3.2 WordStar,	DDS 3.2
	alifites	None	WordFinder Mirror II None	None
None	None			8087
1,200 bps (\$399)	1,200 bps (\$299)	1,200 bps (\$95).	1,200 bps	1,200 bps (\$399) including serial port
testedad	*40			\$75
	Total State Control of the Control	Noise 20MB (\$1.00)	Note	

P—Indicates Editor's Choice ●—Yes ○—No N/A—Not applicable functions style design E—Excellent VG—Very Good G—Good F—Fair P—Poor

Toshiba T1200 \$3,499	Zenith Z-183 \$3,599	NEC MultiSpeed HD \$3,695	Sharp PC-7221 \$3,995	GRIDCase 1530 \$4,695	Dolch-Pack 388 \$4,995	Compaq Portable 386 \$7,999
80086 [4 77/9 54 MHz]	80 C88	MEC V-30 (4 77/8 54 MHz)	80286 (6:8:10 MHz)	80386 (12 5 MHz)	80388 (20 MHz)	80386 (20 MHz)
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10 97	15.88	14.34	20 95	12.89	23 22	21.23
1MB	640K	640K	640K	1MB	2MB	1MB
1MB	640K	640K	1.6MB	smB	10MB	10MB
				·		-
Dre 310-moh	One 3½1-inch	One 33th-inch	One 51/4-inch	Two 33th-inch	One 51/4-inch	One 5%-inch
tioppy disk drive. 20MB hard disk	Doppy disk drive 20 MB hard disk	tiopgy disk drive 20MB hard disk	Boppy disk drive. 20MB hard disk	Roppy disk drives	Roppy disk drive	Toppy disk drive. 40 MB hard disk
None	None	None	None	10MB (\$775),	20MB (\$1,000),	100M8 (\$4.299)
				20MB (\$1,175), 40MB (\$1,695)	40M8 (\$1 500)	40MB tape backup (\$999)
External \$14-inch.	External 5%-inch.	None	None	Various external	None	Second 514-rech
\$499	\$399			drives available		\$225
2.6	3 25	3.6	9.5	2 3	9.5	9.8
12.2	13 75	13.7	16 2	11.5	16.0	16.0
12 0	13.25	12.5	6.2	15 0	7.8	7.B
VG	F	F	N/A	F	NA	N-A
4 25	6 0	5 0	4.5	5.75	4.5	5 5
90	80	9 25	9 75	8.5	9 75	B.5
640 × 200	640 × 200 E	640 × 200 G	640 × 200 G	640 × 400 E	640 × 200 VG	640 × 400 E
,	E	6	0		VG.	L .
82	78	85	102	72	101	101
VG	VG	VG	G	F	G	VG
V6	VG	E	VG	P	E	E
Nickel cadmium	Nickel cadmium	Nickel cadmium	AC only	Nickel cadmium	AC only	AC only
8	8	8	AC only	4	AC only	AC only
2:08	3.30	1.55	AC only	0:43	AC only	AC only
-	:	:	AC only	:	AC only	AC only
\$20	\$19	\$20	AC only	\$25	AC only	AC only
RG8, composite	RGB, composite	RGB	RGB, monochrome	RGB	RGB	RGB
						100
					:	•
1	None	None	1	None	2	None
5 stots, \$999	None	None	4 slots, \$699	5 slots, \$999	3 slots, \$695	2 slots, \$199
(interface, \$199)						
DOS 3.2. SideKick	Microsoft Windows,	00S 3 2	00\$ 3.2. GW-BASIC	ODS 3-2, InteGRIO	00S33	None
	00632			environment, unities		
None	Montor (setup and diagnostics)	Pop-up utilities	None	Custom ROM packs	None	None
The second second	- Andrews					
80C87	8087	None	80287	80387	80287 or B0387	80387
1,200 bps (\$399)	1,200 bps (\$399)	1,200 bps (\$399), 2 400 bps (\$495)	1,200 bps (\$399) including serial port	1,200 bps (\$395), 2,400 bps (\$595)	1,200 bps (\$250), 2,400 bps (salf for price)	1,200 bps (\$349), 2,400 bps (\$699)

The Stan



Graphic images captured by Hotshot Grab.

dards.



The Wyse WY700 Graphics Subsystem. In desktop publishing, PC users have set high standards for themselves. Among displays, their first choice is our WY700 high resolution monitor and video board. It's the best seller by a wide maryin, for reasons that are plain to see. The WY700's sharp 1280 x800 pixel resolution rivals subsystems ossing twice its \$995 price. No one else gives you nearly as many pixels per dollar. And its 15" paper white screen presents two full, truly WYSIWYG pages in high resolution invals.

It should come as no surprise that the leader in displays is also the leader in compatibility. The WY700 now runs over 100 programs in high resolution mode. Including Xerox. Ventura Publisher and Aldus Page-Maker/PC, plus many other DTP applications. And if you do more than desktop publishing, the WY700 supports packages like Microsoft Windows and Excel. Louis 12-3, and AutoCst.

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CIRCLE 734 ON READER SERVICE CARD

WYSE

We make it better, or we just don't make it.



Benchmark Tests: Portable Computers

he benchmark results for this group of 12 portable PCs clearly show that when it comes to portable power, you have a wide range of choices to ponder. The slowest processor times belong to the humble but wonderful Toshiba T1000, which doesn't quite match the speeds of an XT. At the other end of the scale are the Compaq Portable 386 and the Dolch-Pack 386-20-MHz 80386 based machines that match today's best desktop performers (note the blindingly fast display test results for the Compaq Portable 386). The GRiDCase 1530 is also a 386-based machine, but unlike the other two it is a laptop and can be run (for a fairly short time) on batteries. Its top processing speed is just 12.5 MHz; it may not match the AC-powered lunchbox machines, but it remains the most

powerful laptop yet designed. The rest of the machines fall into place with few surprises.

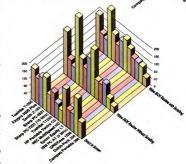
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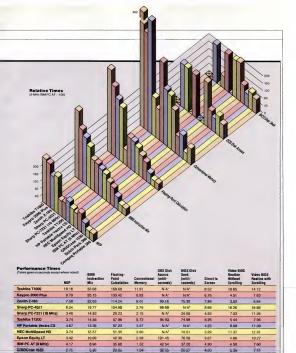
Performance Times **Battery Life** (br.; mie.; se Toshiba T1000 2:02:34 ypro 2000 Plus Zenith Z-183 3:30:23 Sharp PC-4521 2:09:36 Sharp FC-7221 (10 MHz) Toshiba T1200 HP Portable Vectra CS 6.40:34 NEC MultiSpeed HD 1:54:38 Epeon Equity LT 1:40:32 IBM PC AT (8 MHz) N/A* DCase 1530 0:43:08

N/A¹

N/A

Dolch-Pack 386 Compaq Portable 386 N/A¹—Not applicable: AC power on





1.43 3.63

12.47 1.15 32.68 28.03

Dolch-Pack 386

Compaq Portable 386

N.A. Not applicable: no hard disk in unit,

1.65 3.46 12.74 0.60 44.79 34.30 9.66 2.58 6.98

N/A*--Not applic

the usual laptop aspect ratio of 2:28. Expect pie charts to look like ellipses, not circles.

The processor is more than fast enough for standard applications like XyWrie and Lotta 1-2-3. To swhich processor speed from the standard 7.16 MHz to slow mode, you hit a special key called Setup; a menu screen appears, and you can cursor through the various configuration choices. The menu is self-explanatory and contains some wonderful features.

The Sharp PC-4521 competes on price and compromises not on performance but rather on comfort.

The setup program allows you to control things like the rate of curser blink, the speed of the processor, and the video display. It is also smart enough to know if you have installed any internal options. If a modem card is present, for instance, the screen will automatically display your choices for the communications parametonics for the communications parametions for the communication parametion for the computer to turn belfor, or to your up in response to a ring if a modem card is installed. This kind of considerate design adds value to the PC-4521.

The designers paid attention to battery conservation (an important issue for a laptop) by disengaging the LCD's backlighting after 2, 5, or 10 minutes of nonuse. Despite Sharp's good intentions regarding battery conservation, 1 still got only an hour and 25 minutes of normal use before the low-battery alarm sounded.

DISK, PORTS, AND BOARDS The PC Magazine benchmark tests describe the hard disk better than I can. Because it uses hard disk better than I can. Because it uses bear disk was unable to perform our BIOS Disk Seek Test. Still, no problems occur with DOS calls. So on the DOS Disk Acce, test. Still, no problems occur corecs, the PC-4221's disk proved to be comparable to that of an XT, with an average result of 98.68 milliseconds.

The PC-4521 comes equipped with both a parallel port and a port for an external 51/e-inch floppy disk drive. In addition, Sharp provides for optional expansion with proprietary 8-bit add-in cards. You can install an EMS card to increase RAM to 1.6MB, a CRT adapter card, a serial I/O card, or a 1,200-bit-per-second modem

I would not recommend installing the boards yourself. Luckily, I have recourse to the technical help at PC Labs, and I found that I needed it to get the computer apart and the modern in. Once installed, the internal modern worked just fine with MCI Mail at 1.200 bos.

There is some limitation imposed on the mist of boards you can install. The mo-dem card and the serial I/O card, for instance, are designed to occupy the same stot. That's no problem because, in addition to the phone jacks, the internal modem holds a serial port. But don't think you can use the CRT adapter and the EMS card simultaneously—because you can't. They fit into the same stot, too.

LIGHTENING THE LOAD The PC-4521 passed the true test of laptop size: it was comfortable resting on my knees. But at 13.7 inches, it may be a little deep for an airline tray. The version reviewed here weighed 12½ pounds—and if you want the performance of a hard disk and modem, reconcile yourself to it.

It's possible to shave more than a pound from the weight by simply buying a different model. The PC-4502 drops the hard disk in favor of a second microfloppy drive, and it also drops the price from \$2.995 to \$1.795.

And if you are willing to live with 256K RAM, only one drive, and no backlighting, you can purchase the PC-4501 instead. It lightens the load on your pocketbook, listing for only \$995.

The Sharp PC-4521 beats the price of similar machines like the Toshiba T1200, Zenith Z-183, and NEC MultiSpeed HD by anywhere from \$500 to \$700.1 think of it as getting the hard disk for free. The PC-4500 series laptops also come with MS-DOS 3.21—a \$100 value enhancement any way you slice it.

In the final analysis, the PC-4521 competes on price and compromises not on performance but rather on comfort. With the proper modifications to the keyboard and the screen, the PC-4521 would be an easy lanton to buy.—Luisa Simone

Sharp PC-7221

Up front I admit: I've become a luspon anno. I owe my snobbery to months of working with a Toohbu TallOU20. So here I sit writing on an incidy designed Sharp PC "2721 that has all the features you could be a similar to the properties of the prope

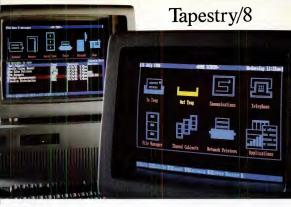
What I will tell you is that Sharp has taken the leap from laptop to lunchbox (an affectionate term for luggable portables) and has come out with the IC-722 I is clearly a field piece—20. FC-722 I is clearly a field piece—20. between the category of small-footprint desktop AT and bigfoot portable. In terms of its computing power, if s not quite up to the speed of the big guns of this issue? so portable showtour the 386-based Company portable showtour the 386-based Company Case 1530. But the PC-722 I matches or beast its closest rivals in features or size:



Sharp PC-7221 Sharp Electronics Corp. Sharp Plaza Mahwah, NJ 07430 (800) BE-SHARP

(800) BE SHARP List Price: With one 5½-inch floppy disk drive, 20MB hard disk, 640K RAM, \$3,995; serial interface card, \$99; 1MB RAM expansion, \$499; printer, \$499. In Short: A full-featured AT-class portable

with nice design features and a price that beats its 386 betters. Switch-selectable clock speeds, expandable RAM, highly readable tilting LCD, above-average keyboard, and expansion slot are its strong selling points. CRECE #TOWNEDGR SPINCE CARD



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CIRCLE 141 ON READER SERVICE CARD



The lunchbox-style Sharp PC-7221 offers 10-MHz 80286 performance and a 20MB hard disk for \$3,995. The portable—as tall and wide as the Compaq Portable 386 or the Dolch-Pack 386 but an inch and a half less deep—weighs in at 21 pounds and is AC powered only. It also features a full IBM Enhanced-style keyboard and a 51/4-inch floppy disk drive as standard equipment.

the Epson Equity LT and the Hewlett-Packard Portable Vectra CS (a.k.a. "The Suitcase").

Cased in dark gray plastic, the PC-Z221's nicest features are those that you can see and touch. The controls and switches are all casily accessible on the face and backside of the unit. The screen controls are set in a panel to the right of the LCD. Side controls adjust contrast and brightness, while an on/off switch toggles between standard and inverse video. A sub blar labled I'm adjusts the screen angle, which has a 15-degree range of motion in 5-degree increments.

When you face the backside, the unit's setup switches are insert at the top right of the unit above the male and female power connectors. Switches toggle among 6-, 8-, or 10-MHz clock speeds; CGA, monochrome, or (when a card is installed) EGA display modes; and built-in or external displays in use. Speaker volume is adjusted with a slide control, always a big plus for me. The monitor, serial, and parallel ports, with plastic dust covers, are arrayed across the bottom of the back panel.

The back panel has just enough screws to deter the curious, but not too many to impede easy entry. Open it up and you're faced with the motherboard. In this case it was obviously a preproduction model, since there were hard-wired patches snaking across the board.

Patches aside, the empty coprocessor socket and partially filled additional RAM sockets, as well as the nickel cadmium batcheries, have open access. The optional 1,200-bit per-second modern plugs directly into the motherboard. Remove a few more screws, and the motherboard itself can be easily lifted from its center-mount-ed plug. Getting to the disk drives is a bit more difficult, since they are enclosed in a

protective aluminum inner case.

Having a machine that can do double duty as a desktop and portable, Sharp wisely allowed room for an expansion slot accessed by removing the bottom panel on the unit. Adjustable mounts and a ribbon cable allow easy installation of a full- or half-card. A removable plate opens the plug for the expansion chassis.

SOLID KEYBOARD Back to the front. the detachable 102-key keyboard locks into position over the face of the PC-7221. Take it off, and the keyboard connects to the unit by a 10-inch coiled cable with modular plugs. When not in use, the cable lies in a tray across the bottom of the LCD. The keyboard's layout rates a "very good," and its solid feel is comparable to those of the Equity LT and the Portable Vectra. The 12 function keys, laid out in two rows at the upper left of the board, are a bit crowded but manageable once you get used to the spacing. In addition, the keyboard has snap-down two-height adjustment pegs on the underside.

Like its laptop cousins in the PC-4500 series, the PC-7221 has an internal setup program hotkeyed by—you guessed it—the Setup key. The program confirms the PC-7221's configuration and allows additions and adjustments. This is one great feature, if only because it does away with a setup disk.

With the exception of its performance on the PC Labs DOS Disk Access benchmark test with a JVC hard disk, where errors were recorded, the PC-7221's processing and hard disk functioned better than I had expected. Though I felt both were somewhat sluggish before I tested them, the runnbers proved me wrong, I experienced no problems using the unit under both Laust 1-23 and XyWrite III Plus.

FIELD PIECE? A few paragraphs ago! called this Sharp a field piece. I employ this term for two reasons. The first applies specifically to its use—out in the field. Stripped to its 20-pound fighting weight, the PC-7221 is an AT-class machine with all the power of a desktop ready to crunch numbers, whip out memos, and write reports wherever an electrical outlet is

The second reason applies to the exter-



anal hardware. Once you saddle on the extrast, you'll practically need a caisson to roll the PC-7221 into action. Its \$499 at attachable thermal printer, basically an Epson FX-80 model, clips on at the rear, extending the depth approximately 3 inches. The bottom-mounted expansion chassis adds approximately 96 inches to the unit's height. Take the PC-7221 on the road fully loaded, and you'r legging around nearly 45 pounds of portable from office to air-port to botel and hack.

Honestly, with all the built-in features and the fact that you can plug into any available printer (or monitor or personal computer, for that matter), it's nice to know you can build a real battlewagon, but it's not necessary.

Given a choice, I'd go with an AT-class portable to lake me into my on-the-road business campaigns any day. But person-aily? want light artillery. Something I can use on my Iap, on the fly, with batteries. The Sharp Pc-7221 has all that it takes, and it's \$1,000 to \$4,000 cheaper than the 3866, but for my taste in portability it's about 10 pounds too heavy.—Gree Pastrick.

TOSHIBA AMERICA INC.

Toshiba T1000

If you're looking for portable 386 processing power, high-performance hard disks, and black-chrome sex appeal, you should pass right over the Toshiba T1000. But if you're looking for the first real DOS laptop computer, you've come to just the right

place. Call me a curmudgeon if you will, but throughout the shower of so-called DOS laptop computers that has rained down from every vender from Bondwell to IBMs. The huge of the year Tanky 200 like Links, to his blanket. For my money, most of the area thout as lap-able in the original Company Tondon's the place of the place of

SMALL PACKAGE Toshiba's tiny T1000 changes all that and—at a suggested retail price of \$1,199—puts a whole new face on DOS lapton computing. It



What the Toshiba T1000 lacks in power it more than makes up for in size and price. Measuring 12½ by 11 in thes and weighing just 6½ pounds, the T1000 can't be beat for portability. Included in the \$1,199 price are one microfloppy disk drive and \$12K R&M. The 1,200-bit-per-second internal modem, essential for on-the-road communications, is \$399.

weighs all of 6½ pounds, and, at 2 by 11 by 12¼ inches, it even fits inside a slimline briefcase, with room left over for a file folder or two.

The T1000 looks and feels like a scaled-down Toshiba T1100. Indeed, its light weight seems to have come from the removal of some gear during the scaling-down process. The T1000 has but one 3%-in-th T1000 has bu

To compensate for the loss of a disk robation of the same and weight-free and power-free alternative in the form of an optional 768K battery-backed RAM acut. The S349 option Toshiba calls the 768 Card can be configured as a RAMfisk, LIM expanded memory, or a combination of both. You can also use 128K of the 768 Card to brine the T1000's standard

512K RAM configuration up to 640K.

You can live without the 768 Card, but you probably won't want to, because it's the key to keeping the T1000 battery alive long enough to take a reasonably long airplane trip while turning this 80C88-



Toehiba T1000
Toehiba America Inc.
Information Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(800) 457-7777
List Price: With one 3½-inch floppy disk
drive. 5128 RAM, 51,199.

In Short: Granted, it's not a lot of computer, but what it lacks in power it more than makes up for in functionality and especially in portability. Six pounds never felt so light. CRCLESTONNEADER SERICE CAPO.

THE QUEST FOR THE "LEAST COMPUTER"

What's the worst PC you're willing to put up with?

That wasn't how I would have put it, but the guy had a point. I'd been looking for months for what I'd been calling a Least Computer for traveling. In other words, the lightest, smallest, cheapest personal computer I could find that still met my minimum requirements—and stood up to life on the road.

The guy next to me on the red-eye from San Francisco had noticed the laptop 1 was using, asked some questions about it, and suffered through the story of
my quest for the Least Computer.

"Sounds to me like what you're really looking for is the worst computer you're willing to put up with," he said, going back to his Tom Clancy paperback.

And he was right.

I'd auditioned a lot of lap-portables for the role. I'm used to the fast, powerful PCs in my office—Compag and PC's Limited AT clones, with a Deskpro 366/20 for most of my own work—and am about as bad a computer-speed junkie as the next power user. And I rely heavily on a fast Toshika T3100/20 as a traveling machine . . . when I know I'm going to be doine Serious Computine on the road.

The T3100 was a marvel when it was introduced almost 2 years ago—and itremains a marvel today; an 8-MHz, hard disk AT clone I can stuff (if barely) into an attaché case. But it weighs 15 pounds, which means I've gotta really want to compute on the road to carry it. And because it's an AC-only machine, I can't use it on airplanes and at other times when I'm not near an AC outlet.

It gradually dawned on me that often , don't need to do such heavy-duty computing when I'm traveling. What I really need on about 75 percent off my trips is a simple MS-DOS machine capable of running my favorite word processor, comm program, and, of course, 1-2-3 (for mini-expense-account worksheets I can /File Combine into the annual expense-tracking worksheets I maintain on my desktop PC.



For which the T3100 is ridiculous overkill.

For years I'd carried my old faithful Tandy Model 100 on business trips. So when I finally tumbled to the fact that I didn't need AT-class computing firepower on these trips, I tried going back to the Model 100.

I learned Tom Wolfe (the original one, not the dandy in the white suit) was right: I couldn't go home again. I was too accustomed to the speed and convenience of my favorite DOS programs. I, 2000-bps moderns, and 720K 3½-inch

disks.
I needed DOS-to-go.
So I tried lap-PC after lap-PC. I found

several I liked, especially the GRiDLite and Zenith's Z-181 and -183. But they were too close to the T3100 in size and weight: for their slight advantages in both areas, 1'd just as soon carry the T3100... though that meant I was still tied to AC power.

Then I discovered the little Toshiba T1000, At 6½ pounds including battery, and small enough to stuff between the shirts and socks in my carry-on bag, it looked like a winner.

I've put about 60,000 miles on my 17000 now. It's suffered almost every indignity, from being dropped several feet onto hard floors, to having wine spilled into it by nearsighted stewardsess and half-drunken searmates, to getting disks stuck backwards into its single 3½-inch drive by an owner who may himself have hit the Bailey's a bit hard while cruising at 35,000 feet. It still works like a charm.

it stan wides had extracted to the ground as well as those lost hours between the SPOs and LCAs and DPWs of the world to work on columns, memos, the standard of the world to work on columns, memos, the property of the standard to work or agreement. On the ground plug the L2004-per modern into the protect limited to the standard protecting t

The TI 1000 is hardly perfect. By contrast with the 28 and 386 machines I'm used to, its 4,77-MHz 8088 is painfully slow. The keyboard is rattly, and keytravel is too short. The display uses ugly little characters that sit on top of one another, and the supertwist LCD screen needs to be backlif. The internal modern has just one jack—for a cord to the wall—so I have to carry (and frequently lose) a separate T-adapter If also want a telephone plugged into that line.

I want access to the T1000's internal battery, so I could swap it with a second, charged cell when my flight is longer than the 4-hour life of that battery—or when I forget to charge it.

And the carrying case—which I finally discarded—has this fiendish little open-top disk pouch that's carefully designed to throw your disks across the room the instant the case is unzipped. Don't they have Velcro in Japan? (Is Velcro the undiscovered answer to our trade deficit?)

All of that pales, however, every time I pick up the T1000 and smile as I wedge it into my carry-on bag. Because, simply put, it's the Least Computer I've found that I'm happy using. And at \$750 to \$800 (street prices), it's an incredible bargain.

"Worst computer," heck. If matching computing power to the task at hand is the name of the game, the T1000 is one of the best computers I've ever used.

—Jim Seymour

powered laptop into a realistic (by today's standards) DOS computer. The T1000's battery lasted for just over 2 hours when the PC Labs battery-life test was run using the floppy disk (the test keeps writing the current time to a file on disk until the battery dies).

I wouldn't want to use the Toshiha T1000 to write the entire great American novel-just a chapter or two at a time.

Using the RAMdisk, the battery stayed alive for nearly 4 hours, and the data stored on the RAMdisk was alive and well when the T1000 was powered up later on. A Toshiba product manager says the company has tested the B-RAM for up to 7 days with no problems.

The other reason the 768 Card is practically required for the T1000 is that using the B-RAM as a RAMdisk makes the machine perform like an XT having a really good day instead of a floppy-diskequipped AT having a bad one. This RAMdisk's performance closely resembles that of the hard disk on an AT, and even disk-bound programs like Microsoft Word take on new laptop life when you install them on the T1000's RAMdisk-without the power and weight penalty of an on-board hard disk.

And just to be sure you're happy with only one magnetic drive on your laptop computer, Toshiba installed DOS in ROM chips tucked away on the system's circuit board, so you don't have to take up room on your floppy or RAMdisk. The only penalty here is that you're stuck with MS-DOS 2.11, although you can configure the machine to boot another version from the floppy or RAMdisk.

SCREEN QUALITY Supertwist LCD screens aren't great, but when you're looking for a decent compromise between visi-

bility and battery life, they'll do just fine. The Toshiba version works well enough for most airplane usage, and the only time it'll get you into serious trouble is when your bus or train goes into a tunnel or the city goes into a blackout-a small price to pay if light weight and battery life are important issues in your choice of a laptop. Besides, you can hook up your CGA or composite monitor for home or of-

fice use. Most of the T1000's keyboard is the same serviceable unit used on the T1100. The only big difference is that the top row of keys-including the Esc. NumLock. Scrolll ock PrtSc and function keys-are half-sized versions. I like this change because their smaller size gives these keys a different feel and makes them easier to locate by touch. Toshiba offers a numeric keypad as an option for \$99.

One keyboard oddity is the presence of an AT-like SysReq key, which is used to call up a screen attribute configuration menu when you install the pop-up version of Toshiba's screen utility. Otherwise, the keyboard feel and layout are good for a laptop machine but, as with most portables, I wouldn't want to use the T1000 to write the entire great American novel-iust a chapter or two at a time.

You can also install Toshiba's Havescompatible 1.200-bit-per-second modern in the T1000. It costs \$399 and isn't much fun to install yourself, but it can be done and the results are just fine: MCI Mail and Citibank Direct Access came to life without the slightest hint of trouble.

The word wimpy is often heard when the T1000 is discussed, mostly because of its 4.77-MHz 80C88 performance. But if you're using a laptop only for word processing, communications, and occasional heavy-processor applications like spreadsheets, this little guy is just the ticket. For that matter, at a New York street price of under \$800. GRiDCase owners might want to buy a T1000 so they have something to do when their battery dies. - John Dickinson

TOSHIBA AMERICA INC. Toshiba T1200

Like the amazing T1000, Toshiba's T1200 is a collection of quality components squeezed into a box inches smaller and pounds lighter than the competition offers. Those parts include an 80C86 processor



running at keyboard-selectable speeds of 4.77 and 9.54 MHz, 1MB RAM, one 720K 31/2-inch disk drive, a 20MB hard disk, and a supertwist LCD screen.

While the T1200's \$3,499 price tag causes a momentary wince, the \$3,599 Zenith Z-183 and the \$3,695 NEC Multi-Speed HD put things in perspective. A similarly equipped Epson Equity LT costs about the same as well. What those machines have that the T1200 does not is a backlit screen. In the Toshiba's favor is its diminutive size. There is no comparison with the Z-183, and the MultiSpeed is an inch thicker, an inch and a half wider, and a half-inch deeper than the similarly configured T1200. Unlike most laptops, this one fits on your lap.

RAMDISK The T1200 lets you take any slice of the 384K RAM above 640K and turn it into a speedy hard RAMdisk that will cut down hard disk access, thus increasing battery longevity. You can also enable a special battery-powered RE-SUME feature that will save the data in hard RAM when the machine is turned off.

When you turn on the lapton again, you find yourself at the exact spot where you left off; there's no need to save the data first-and no need to write to floppies. Virtual disks can also be simulated within the conventional 640K RAM. Setup for these features is accomplished through a straightforward setup menu.

One of this laptop's most useful features is its removable battery pack. With an optional battery charger, you can maintain an extra supply of fully charged batteries at all times. When the low-battery indi-















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The Toshiba T1200 provides most of the same features as the NEC MultiSpeed HD, the Epson Equity LT, or the Zenith Z-183, but in a smaller package (12 by 12 inches). Priced at \$3,499, the T1200 includes a nonbacklit superrovist LCD screen and a 20MB hard disk. Battery life with moderate disk access is a little over 2 hours.

cator light starts to glow, just pop in a fresh battery pack and keep computing. In PC Labs testing, the discharge time of one battery pack was found to be a little over 2 hours.

The T1200's keyboard is a model of both neatness and organization, 18x3 keys include ten full-size function keys placed across the top and four dedicated cursor movement keys arrayed in an inverted.¹¹ joutu. A numeric keypad is embedded in joutu. A numeric keypad is embedded in side of the keyboard, and a special Fin key at the left of the Speccher is used to activate all the second-level key operations, Keyboard feel tas well asl jouqui was rated as very good by VC. Magazine's editors, clicks quite andibly, but the steady hum of the jets during an airplane flight is more than enough to drown it out.

LET THERE BE LIGHT If you use the T1200 in a darkened airplane, however, you may wonder why Toshiba has not included a backlit screen as Epson, NEC. Sharp, and Zenith have on their hard disk laptops. The best reason (and perhaps the only reason) to stick with an unlit LCD is to lengthen battery life. The supertwist LCD screen is quite readable in adequate light, but if you find yourself in a dark place without a light source, you may as well go to sleep. Back at the office, you can avoid the screen altogether with the RGR and composite monitor interfaces that are standard with the machine. The base price of the T1200 includes

MS-DOS 3.2, Borland's Side/Kirk, a suntry currying ears, and documentation that is clear and illustrated with color photographs. Two types of 1.200-bit-perseccord modern are available; either one costs 3599. The advantage of the factory-installed, built-in modern is that it does not occupy the T1200's single expansion that resides in the expansion dates that the darket size of the best person of the size of the size of the contraction of the size of the size of the color of the person of the size of the size of the size of the companion of the size of th

Despite the lack of a backlit screen, the T1200 is an able competitor in the \$3,500, 20MB hard disk laptop category. Other machines may have better screens, but if you submit all the competition to the dreaded tape-measure test, Toshiba emerges the winer.

-Donald P. Willmott

ZENITH DATA SYSTEMS Zenith Z-183

At just over 16 pounds, the Zenith Z-183 is a real ams-strecker. While other potenties sport exotic new CPUs, this one plotds along with an anathonistic CMOS list. Its function keys were designed by some one who obviously doesn't move his finence who obviously the plant has the property of the PCPy obviously to execute a PgUp, PgDn, Home, or End. Worse, since its clambfull streen fasters to the very rear of the case, when



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The Zenith Z-183's new 20MB hard disk keeps it competitive with more-recent arrivals, and its brilliam backlit screen still outshines the competition. This laptop, which weighs about 16 pounds, is based on an 80C88 processor numing at 8 MHz. The price of the 10MB version has dropped to 33,199, and the 20MB model sells for \$3,599.

crunches his airplane seat against your knees, it's time to save and quit.

But this is still a gem of a machine. The body is sleek and solid; it's one gorgeous white wedge. Everything, from the sturdy retractable handle to the double-thick Lexan door that snaps authoritatively over the I/O ports, whispers quality. In a world of filmsy, wobbly toy laptops, the Zenith Z-183 is an engineering mary.

And that unparalleled full-aspect screen—with lush, deep, saturated blue text against a throbbing silvery—white background—continues to drop jaws every time it's popped on. The thing is so large, bright, and readable that it looks like a carnival trick.

Zenith didn't really change its earlier model 183 other than slipping in a hard disk that's slightly faster (at 73 milliseconds average access time), and twice as large as the original 10MB hard disk. Why tamper with success? The S-MHz 8-bit CPU is no barn-burner, but it gets the job done.

Apart from the uninterrupted swath of Chiclest-style function keys spanning the top row, the Zenith Z. 183's 78-key key-board layout is both spacious and sensible. It avoids the cramped, claustrophobic fed of smaller laptops, and sports a true discrete cursor diamond in the lower-right-hand corner, a large 3-shaped Enter key. Shift keys in the proper places, and an al-

phanumeric arrangement mostly the same as that of a classic AT. Green LEDs wink on to indicate Shift states. Raised Brailletype dots keep your fingers centered over the F and J keys. The Z-183's key action is properly stiff and springy; half the hard-

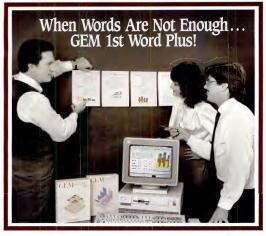
The display on the Z-183 is so big and easy to read that I consciously have to mute it when I'm flying somewhere.

ware that we tested came with mushy, wimpy little buttons where the keyboard should be.

SIPERSCREEN Just about every other buttery operated system slaps a pint-sized display onto an otherwise respectable chassis. These slawys end up looking as chassis. These slawys end up looking as circular tubes on early-1950 colimet-sized TVs. (Driving a duft, squinty screen with a hot CPU is like hooking up a brand-new enderson system so the plays through the twisterso systems only large butter of the property of the property

While other portable manufactures make you fumble around to the side of their systems to switch disks, Zenith lets out side their systems to switch disks, Zenith lets you slick them in and out from the top—real convenience when you ire sandwiched manufactures and the systems of the systems

The screen connects to the body with a silky-smooth friction hinge that locks it firmly in place over a wide arc of viewing angles. You can control the contrast and brightness with handy sliders directly



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PORTABLES



GRiDCase 1530
 Toshiba T1000

Though the GRiDCase 1530 and the Toshiba T1000 are very different laptops, they share one important characteristic: outstanding design. With a list price of \$1,199 and street prices \$300 to \$400 lower, the T1000 may become the essential laptop. It is totally portable, very rugged, and it gives you enough power on the road to write and communicate smoothly-the two applications that laptop users need most. Hats off to Toshiba for designing a 6-pound machine that some people are calling the first real laptop computer.

At the other end of the price and power spectrum is the CRID/Case 1530. Never before has so much power been superced into a laptop design. Like the T1000. The 1530 is extremely portable, but unlike the T1000, it allows you to take all your desktop data with you on the road and access and use it with blinding on the the thing of thing of the thing of thing of the thing of the thing of the thin

Many people are willing to travel with an AC powered lunchbas style portable in order to have industry-standard expansions isoles and extra-large hard disks available to them. In that category, the Compay Portable 386 is the machine to tote along, the standard power is unsurpassed by any other portable, and you may even consider stang it as the utilization of the power is the standard power is unsurpassed by any other portable, and you may town to the distance of the power is the standard power in the standard power in the standard power is the standard power in the standard power in the standard power is the

above the top row of keys. Since the luminous panel that provides the backlighting is such a power pig, this makes it a snap to dim the screen between bursts of typing. You can also have the system blink the

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■ PORTABLES

backlit panel off automatically at just about any interval you want.

Zenith's original power supply came with a short cord and a nasty habit of melting if you left it plugged in too long. The new one solves both of those problems and is relatively light and compact. To conserve juice, virtually everything under the hood-the floppy controller; serial, parallel, and RGB ports; modern; and hard disk controller (but not the hard disk motor_chute down when not in use

Standard-issue C cells will keep things going for 2 to 3 hours, but you can purchase D-sized nickel cadmium batteries that will nearly double that. A low-power light flashes and the system beeps annoyingly when the batteries are nearly spent. However, if you accidentally close the lid without snapping off the power, the system won't warn you, and the lid will muf-

fle the eventual beeps.

The standard Zenith Z-183 comes from the factory with 640K RAM, one 31/2-inch 720K floppy disk drive, a 10- or 20MB hard disk, DOS 3.2, keyboard-selectable LCD/RGB output, a real-time clock, 9-pin serial and 25-pin parallel ports, and a port for an external floppy disk drive or a bar code reader. A side-mounted DIN connector lets you plug in an optional numeric keypad or even your favorite PC keyboard, and you can plunk in an 8087 math coprocessor.

Zenith's firmware Monitor program lets you perform assorted tests and DE-BUG-like functions, customize the display attributes, and even adjust the screen so that it does "smooth scrolling" rather than jumping the display up a line at a time. And Zenith not only furnishes a slate of ondisk utilities to streamline your operation but actually makes them almost friendly. For instance, typing "MODE?" pops up a series of help screens that sort out the complex commands needed to do proper hardware configuration.

If you crave raw, brute power in the tiniest possible package and you don't mind reading in the dark, you may be better off with other systems. But if you're planning to spend close to \$4,000 on a road machine and you want the sturdiest, best-built, most stylish, most readable laptop on the market, snap up one of these.

-Paul Somerson

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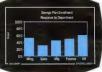
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N WESTERN CANADA STEPLING MICRO SYSTEM P TEL (804) 270-3233 In his September 15, 1987, column, contributing editor Jim Seymour hit the nail on the head when he pointed out an oft-forgotten truism in the PC industry: "Software sells hardware." Take monitors: were it not for software that demanded greater precision and the ability to display more-complex images, ultra-high-resolution monochrome monitors would probably never have come about.

It's only been a few months since PC Magazine last surveyed premium monochrome monitors (see "Screen Gems,"

BLACK-AND-WHITE MONITORS: THE DESIGNER COLLECTION

DTP and CAD users have put monochrome monitors back in the picture. With great new drivers for spreadsheets and word processing, black and white may be the only colors you'll ever need. PC Magazine, November 24, 1987), but this market is burgeoning so quickly, both in sales and in product variations, that we decided to have another look.

una we'decuceto in avee dictie; nosc. compater-niced design CAD) are the rations of eirer for these light-resolution monitor.

CAD is ent the rations of eirer for these light-resolution monitors are considered to the control of the rathernic choicing black character or lines on a white background. While IBM's conventional display adapters have been showly increasing the legibility of video images since the PC's inception, graphics-based programs are merely acceptable, at best, on ordinary display systems.

STANDARD MODES IBM's standard video modes range from the uninspiring, represented by the Color/Graphics Adapter (CGA) (with 640- by 200-pixel resolution in monochrome mode), to the adequate, in the PS/2's Video Graphics Array (at 640 by 480 pixels per screen).

Color makes the VGA image (and, to some extent, that of the Enhanced Graphics Adapter) more legible and certainly more interesting, but it doesn't help in putting any more of the

water	MEC MultiSync GS \$279	Amdek Monitor/1288* \$999	Wyse WY-768* \$999	Princelon LM-388 \$1,500	Princelon LM-381 \$1,500		NEC MonoGraph \$1,995
Orientation	Landscape	Landscape	Landscape	Portrait	Landscape	Portrait	Square
Screen size (inches)	14	15	15	15	15	15	16
deximum pixel resolution horiz. by vert.)	720 × 480	1,280 × 800	1,280 × 800	1,200 × 1,664	1,664 × 1,200	736 × 1,008	1,024 × 1,024
Controller	None		1280 Graphics Adapter Card		PG-1600 Interface		MonoGraph System Board
BM modes emulated	CGA, EGA, Hercules, MCGA, MDA, Super EGA, VGA	CGA, MDA	CGA, MDA	None	CGA, MDA		CGA, Doublescan
hrivers	None	GEM, Lotes 1-2-3, P-CAD, Symphony, Windows	GEM, Lotus 1-2-3, P-CAD; Symphony, Windows	DOS BIOS Driver, GEM, Paga Maklar, Mindows, Word/Perfect, Word/Star	AutoCAD, GEM, PageMaker, PC Paristrusth Plus, Thristrusth Plus, Territoria Publisher, Windows	AutoCAD, FormMaker, GEM, Lotus 1-2-3, Microsoft Word, PC Paintbrush Plus, PC Write, Publisher's Paint brush, Samne Word IV, Spetthin der, Symphony, Windows, Wordows, WordFerfect, WordFerfect,	
louse controller on-board	0	0	0	0	0	0	0
lue type	None	PC bus	PC bus	PC bus	PC bus	PC bus	PC, XT, AT bus
faximum bue speed	N/A	16 MHz	16 MHz	16 MHz	16 MHz	20 MHz	10 MHz
	•	0	0	•	•	•	•
nternally powered		•	•	0	0	0	•
	0						•
lowered by computer	•	•	•	•	•	•	•
Powered by computer Primary dieplay capability	-	•	•	:	:	•	•
internally powered Powered by computer Primary display capability Secondary display capability Itt/swivel base	-						:

image on the screen at any one time.

This may not be important with most conventional applications like spreadsheets or even CAD programs, but for DTP applications it's practically a must. The only way to visualize the impact of a page layout is to see it as it will actually appear rolling out of a printer, especially if

that printer is a laser. Here is where the paper-white monitors come into their own. With resolutions as making them possible. Most significant of

high as 1,600 by 1,200 pixels, they can easily project not just one perfectly represented page but, in some cases, even two at once. The character images may not be very large, especially on the smaller 13-

inch units, but they will be crisp and clear. Although the requirements of DTP applications may have made these monitors desirable, we have a number of recent technological improvements to thank for

these are increases in the signal bandwidths and video scan rates over previous

designs. In simplistic terms, the bandwidth translates into the number of pixels that can be discriminated across the horizontal

axis, while the scan rate determines the number of pixels along the vertical axis. The entry-level CGA monitors are characterized by vertical scan rates of 15.75 kHz, the same as a conventional

Taxon Crystal View \$2,195	Thomson 980W \$2,290	Cornersione Vista 1600 \$2,395	Monitarm Viking i \$2,395	Sigma LeserView Plas \$2,395	Monitarm Viking Portrait \$2,595	ConoVision 2000 \$2,620
Landscape	Landscape	Landscape	Landscape	Landscape	Portrait	Portrait
19	20	19	19	19	19	19
1,280 × 960	1,024 × 768	1,600 × 1,280	1,280 x 960	1,664 x 1,200	960 × 1,280	720 × 2,880
TX-1280	Thomson AGC	Vista 1600 Custom Controller	Viking 1 Controller	LaserView Plue Display Adapter	Viking 1 Controller	CV-2800
CGA	CGA, Hercules, Monochrome	Hercules, MGA	CGA, Hercules, MDA	Hercules	CGA, Hercules, MDA	Heroules
AutoCAD, GEM, Windows	AutoCAD, Windows	AutoCAD, Dr. Halo, Page Maker, Publisher's Paintbrush, Ventura, Windows	AutoCAD, CAD- varice, Form- Makier, GEM, In' a' Vision, In' a' Vision, Page Maker, P-CAD, Symphony, UNIX, Ventura, VersaCAD, Windows	AutoCAD, GEM, Lotus 1-2-3, Page- Maker, PC Paintbrush, Symphony, Ventura	PageMaker, Venture, Windows	AutoCAD, Cr. Halo III. Lotus 1-2-3. Publisher's Publisher's Wintura, Windows
0		•	0	0	0	0
PC bus	PC. AT bus	XT bus	AT bus	XTbus	AT bus	PC bus
20 MHz	20 MHz	10MHz	10 MHz	8 MHz	10 MHz	20 MHz
0	0	•	0	0	0	0
•	0	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	0	0	0	0	0
6	41/2	5	6	5	6	5
•	•	•	•	•	•	•
0	•	•	0	0	0	•

television set. To get an acceptable image, though, the CGA monitor typically has a bandwidth of at least 15 MHz—about five times that of a TV (and the reason why only hopelessly impoverished video game players would consider using a TV as a video display today).

Paper-white monitors, at the other extreme, can have video bandwidths as high as 160 MHz along with 70-kHz vertical scan rates. INTERLACED DISPLAYS In order to reduce costs, some manufacturers resort to interlaced displays, a technique that illuminates alternate vertical scan lines on every other refresh of the scanned image. As a result, the display can operate with

a vertical scan rate only half that of a noninterlaced system and still effectively yield the same number of vertical pixels. It does this at a lower cost.

The disadvantage of interlaced displays



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is that the image often has a noticeable flicker to it, particularly on gray-scale graphic images. To make this image fluctuation less prominent, most builders of interlaced displays resort to longer-persistence phosphors in their picture tubes.

An often-quoted figure for color displays is the size of the dat pitch—the size of the actual physical area illuminated by each pixel, with the best units claiming dot sizes as small as 0.18 millimeters. While dot size is a function of the image mask inherent in all color systems, it is in a factor in monochoure displays. In the latter, dot size is a function of their bouldwith the size is a function of their bouldwith the size of the monitor is capable of displaying, with the better systems running in the 0.1 mm ranes.

Combine this level of visual acuity with the accurate impression of the printed page found in a monochrome, and it's not hard to see why these displays are coming back into the picture.

HARD CHOICES Though by now you may have started to salivate for one of these beauties, a number of hard choices remain

Depending on your primary reason for using a page-white monitor, the first clear question is the layout of the picture tube. The most popular of these islepslays have the picture tube oriented the same way as in conventional monitors, with the long axis arranged horizontally. This arrangement is commonly referred to a standacque orientation, a term we owe not to computer engineers but to horbotrambers.

A camera picture frame similarly oriented with respect to the horizon allows more of the countryside to appear on the image, with less space wasted on the sky and foreground. Landscape format is generally preferable for CAD and many conventional DOS applications, such as communications and databases.

By contrast, portrait-format monitors are named for the photographer's endency to orient the long axis of the film vertically when shooting portraits. To a photographer, this format places more of the subject on the image, with less blank space wasted on the sides.

To us, however, these monitors more tion Manager becomes available accurately represent the standard 81/2-by- 30236- and 50336-based machines.

II-inch sheet of paper on which the finished product will appear. Such monitors first appeared on professional phototype-setting equipment over a dozen years ago, but, with prices exceeding that of a small home, these systems never had a chance in the general marketplace. Portrait-format monitors are generally best for DTP and some word processing applications (given the necessary software drivers).

As to which format is preferable for spreadsheets, it's really a toss-up. With the right drivers, the landscape formats often show more columns and more rows. Portrait monitors, on the other hand, can display more rows but seldom show more columns.

The physical size of the display image would seem to be straightforward the big-ger, the better. Not necessarily. If the majority of your work will be with DTP or CAD programs (and most others running under the Microsoft Windows and GEM graphics interfaces), then the increased size is beneficial. But the really big 19-inch-pias monitors are actually too big if the balk of your time is spent with standard the balk of your time is spent with standard in the control of the programs of the pro

MORE COMPLICATIONS To further complicate the issue, paper-white monitors cannot be selected on the basis of display alone. There's also the consideration of their requisite video board and the software drivers necessary to run most programs. Each contributes roughly half the functions necessary for operation with most software packages.

The software drivers allow programs originally written for conventional IBMstandard video displays to take advantage of the enhanced image that paper-white ponitors are canable of delivering.

Virtually all of these packages include drivers for the two most popular graphics interfaces: Microsoft Windows and Digital Research's GEM. With these drivers, you can be sure that the monitors will work with the current TPT Pavoristis (Page-Maker and Ventura Desktop Publisher), as well as the applications that should appear in the near future when OS/2's Presumed and the property of the publisher of the property of the proper

In addition, some of the monitors have instructions for patching currently available applications (such as Latte 1-2-3 and Wordstart) to take advantage of the increased display area using nothing more than DEBUG A warning; don't ever attempt to install the patches on your original disks: use only backup copies. DEBUG isn't known for its ease of use, and a mistace on an original could be disastrous.

For most conventional programs, however, the ability of the adapter board to emulate one or more of the current video standards (CGA, MDA, EGA, and Hercules) is likely to be more useful. Virtually every piece of software ever written for the PC supports at least one of these standards, and while the results may not take advantage of all of the capabilities of the paperwhite display, they do extend its usefulness enonemous!

DISPLAY BOARD CATEGORIES Display boards fall into two distinct categories: those with their own video coprocessors (like the Texas Instruments 34010 or the Intel 82786), and those that rely on the host processor. In every case, with the exception of the \$279 MultiSyne (Sg, which can be adapted to any video board, prices include a display adapter card.

Those with resident coprocessors are considerably faster at updating the display screen (an important consideration in CAD applications), but they aren't always be best at mimicking standard modes. Never theless, their increased speed makes them the only reasonable choices for use with slower 8088—and 8086-based CPUs. Stower 8088—and 8086-based CPUs. The stower 8088—and 8086-based The Stower 1884 MDA) quite well, but they rim infraiingly slow on anything less than an 8-MHz AT or better.

There's a temptation to contemplate what would happen if one manufacturer's video board were used with another's monitor. The result, however, could easily prove disastrous. Because of their often-high power consumption, some of the boards are powered by the monitor's power supply. It doesn't take much to figure out that them is-and-match approach could send the monitors, video board, and even the CPU's motherboard up in smoke.

The final puestion is just how deep your

pockets are. None of these display systems are cheap, running from 5990 to \$2,60. If you're entrenched in DTP or CAD requirements, go for the top of the line—they're worth it? But if your interest in graphica-interface—based applications is only occasional, and your main aim is for one of the finest monochrome systems available, then the less-expensive models should serve admirably.

AMDEK CORP. Amdek Monitor/1280

Wyse WY-700

Price is something that's seldom meninord as a feature when talking about paper-white monitors. For the most part, they tend to cots as much as or more than their host CPUs, but that's not the case with Amdek Corp's little Monitor/1280. At a buck under a grand, it's still not exactly something you'll buy without thinking twice, but its features nevertheless make it a baverain.

Aridek's Monitor/1280 and Wyse cechology's WY-700, to begin, are the same product: the Arndek is sold on the retall level, the Wyse through original equipment manufacturers and value-added resellers. There was a time when Arndek and Wyse were competitors in the monitor marketplace, but all this changed when Wyse bought out Arndek. (For simplicity's sake, both products are referred to here as the Arndek.)

Outwardly, the Amdek is considerably more compact than the big 19-inch displays, and it doesn't look nearly as ridiculous as one of those monsters would sitting on top of a PC.

In fact, among the monitors tested here, the Amdek (along with the NEC) is one of the few monitors that I would contemplate placing on top of a plastic-cased PC clone. The Amdek's beige all-plastic cabinet is attractive and helps contribute to its low 28-pound weight.

Also significant in reducing its weight is the Andeck's picture tube. Advertised as measuring 15 inches diagonally, the screen turned out to be only 13½ inches. Whether the CRT is larger under the front bezel really doesn't matter; only the actual viewing area counts.





The economical Andek Monitor 1280 (S999) offers high legibility for standard DOS applications, but its small characters and limited display area are best suited for only occasional use in CAD and desktop publishing.

HIGHLY LEGIBLE DISPLAY Partially because of its smaller size, the Amdek offers one of the most legible displays I've tried with conventional DOS applications.

A viewing distance of about 24 inches tends to be optimal for applications like word processing on a typical monochrome monitor. Text display on the Amdek is easily readable at that range. Larger displays, such as the ConoVision and Taxan, are best viewed at distances of at least 30 inches—if you happen to have a desk deep enough to allow that.

Another important factor that contributes to legibility is the dot pitch used to make up individual character cells. IBM's CGA standard uses an 8- by 8-pixel character cell, resulting in coarse, fuzzy characters.

The Amdek, instead, uses a 16- by 32pixel cell when emulating either a CGA or an MDA board. As you might expect, the resulting fully formed characters are delightfully crisp and legible.

But for DTP and CAD applications, the petite screen is better used only occasionally. The resolution, at 1,280 by 800 pixels, is certainly high enough to pack a great deal of information on the screen. The resulting characters, however, are too small to be read easily without your moving uncomfortably close to the screen.

To achieve its level of resolution at a modest price, the Amdek relies on interlacing, a technique in which alternating lines of pixels are illuminated on every other vertical refresh pass of the electron beam. Hence, there is some flickering, or shimmering, of the image, which becomes puricularly velocited against a white baxis-ground (the preferred mode for DTP). The medium-persistence phosphor used in the CRT helps to some extent, but it introduces its own peculiarly: a ghost made that lingers for about half a second after a brighty illumination pixel is more personal to the property of the prop

Inotically, one result of the phosphor's relatively long persistence is that this monitor seems to work best in a brightly illuminated environment—the bane of many other monitors. The Amdek's suitability for a bright office is further enhanced by an etched screen with what appeared to be the lowest glare level of the monitors reviewed. The tilt-and-swivel base helps climinate virulavl awn remaining water.

QUICK IMAGE UPDATES No highresolution monitor would be of much use without a corresponding display adapter, and the Amdek board set (a full-length board with a similar-size daughter-ard) appears to be of above-average construction





Returns From Peru

Rare Plant

The wyse WI-/ON uses phosphor and an eiched screen to create one of the best display, for brightly lit environments. Its compact size and relatively low price combine to make it one of the more affordable and efficient monitors.

FACT FILE

Amdek Corp. 1901 Zanker Rd. San Jose, CA 95112 (408) 436-8570

Wyse WY-700 Wyse Technology 3571 N. First St. San Jose, CA 95134 (408) 433-1000

List Price: \$999

Requires: Full-length siot: DOS 2.1 or later.

In Short: The sum monitor is marked under different model names by both Wyse and Amdel. An excellent holice for everyday applications, it offers a bright, legible display that is perfect for long-lerm sessions with word processor or spreadsheer. For DTP and CAD. Monigh, the shall, interfaced sevens heter suited to consistent user. The legisin price (computatively speaking) makes in flavor some integrity of the control of the series of the se

quality. Based on the Motorola 6845 video coprocessor, it results in gratifyingly quick image updates despite its support for only an 8-bit bus structure.

Software support for the Amdek is fairly sections to the package and from third-party vendors. Drivers are included for GEM (Versions 1.2 and 2.11). Microsoft Windows, and Lotus 1-2-3, Release 2.01 (this last enabling a display of spreadsheets measuring 160 columns by 50 nows).

The list of third-party software vendors supporting the Amdek continues to grow, as evidenced by the lates releases of Auto-CAD, Generic CADD, P-CAD, In*a*Vision, VersaCAD, Javelin, ByLine, Dr. Halo, WordStap Professional, and PC

Paintbrush Plus, to name but a few of the most common. As of this writing, the Amdek is supported by over 90 programs; as its sales grow, so will its support.

Besides the drivers, the disk also contains a utility for clearing the screen after a preselected length of time: a program that acts like the DOS CLS command but clears all of the screen regardless of operaing mode. A utility called SCREEN selects display modes ranging from 80 characters by 25 lines on up to 16 by 50.

For the most part, though, the extended display modes are useful only at the DOS level or with basic programs, since most commercial applications will restore the display to 80- by 25-character mode upon startup, no matter what mode happened to

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be selected by the user at the DOS level.

Despite their limited display area and interlaced design, the Amdek and Wyse monitors rate as a best buy when high resolution is required at a reasonable price. Let's face it, if we had the money, we would all be driving a Jaguar-but those little batchbacks are so much cheaper and more practical . . . and so darned cute. That's the impression conveyed by these gems.

CONOGRAPHIC CORP.

ConoVision 2800

By now, the Conographic name is familiar to nearly everyone who's serious about desktop publishing. A leading supplier of name-brand typefaces for laser printers, Conographic's products make DTP publications look like custom-typeset layouts rather than something cranked out of an old dot matrix that's missing a wire in its printhead.

It follows, then, that the company would offer a display package-the \$2,620 ConoVision 2800-that fully integrates the PC with a laser printer. All that remains is for you to select a suitable DTP program.

The ConoVision 2800 display adapter is unique among these packages in that it has two connectors on its rear strap; one for the monitor and one for a laser printer. The printer port is capable of controlling any printer that uses the Canon LBP-CX en-





The ConoVision 2800 offers a rich set of drivers, Hercules Graphics Card emulation, and a large display area. If you can tolerate the shimmer produced by interlacing, the ConoVision is a good sinele-manitar video salution



Concernable Com 16802 Aston St. Irvine, CA 92714 (714) 474-1188 List Price: \$2,620 puires: Full-length slot, DOS 2.1 or later. In Short: If you can live with the slight shimmering from the interlaced image, then the ConoVision 2800 is clearly a contender for

your DTP and CAD applications. The ability to emulate the Hercules Monochron Graphics Adapter also gives it good, if not outstanding, functionality with everyday

DOS applications.

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gine, which includes the Hewlett-Packard Laserlet series and the Cordata systems.

An additional driver, supplied on the device driver disk for application software, supports the Tall Tree JLaser board using Lotus-Intel-Microsoft (LIM) expanded memory. This also makes it a likely candidate for AutoCAD image printing, which also supports the JLaser board.

Additional software support for the ConoVision 2800 comes in the form of drivers for Microsoft Windows, AutoCAD, Ventura Desktop Publisher, Media Cybernetics' Dr. Halo III. and Z-Soft Corp.'s PC Paintbrush Plus and Publisher's Paintbrush. Only the Ventura driver set, though, is capable of handling all of the printer controls as well as the screen display: the others are limited to the video graphics alone.

Perhaps of equal importance to many will be the optional (\$50) driver disk for Lotus 1-2-3. Release 2.01, which came with our review unit. It enables the CV-2800 to display spreadsheets of 160 columns by 39 rows, as well as 1-2-3 graphics. Both spreadsheet data and graphic images can also be imported into the Ven-

tura and PageMaker screens. It's just unfortunate that, for the high price of this (and every other) paper-white monitor, Conographic didn't include the

1-2-3 drivers without an additional charge. The monitor itself reminds me of a line from the movie M*A*S*H: "I've seen your face before, stranger, but the name If you're looking for powerful software to solve your network problems...



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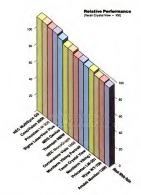
For network solutions, you should be seeing red.



Benchmark Test: Black-and-White Monitors

White the overall contrast level of the monitors tested varied by less than 20 percent, all of the results represent highly monitors tested varied by less than 20 percent, all of the results represent highly control of the CEC boxoc/Gaph's beautiful less!, the lack of inferration, and the control of country in the edge

	Black-White Ratio
NEC MultiSync GS	184
ConoVision 2800	184
Princeton LM-300	183
Sigme LaserView Plue	1:8:3
MDS Genius	1:8.1
Thomson 980W	1:7.8
NEC MonoGraph	1:7.8
Cornerstone Vista 1600	1:7.6
Moniterm Viking Portreit	1:7.6
Texan Crystal View	1:7.5
Moniterm Viking I	1:7.5
Princeton LM-301	1:7.3
Wyse WY-700	1:7.3



Black-and-white monitors are considerably higher in contrast than most point on paper. Light readings of standard single-impression blacks print on that white paper shows a single-impression blacks print on the white paper shows a sard-white monitors is considerably higher, about 17.7 the soft of the paper shows a single show ratio from modeling off printed paper occurs because light is reflected from the page, while the higher ratio from monitor a data to the bright, directly transmitted forces-

conco of the screen. This high basis while ratio should mean that a biasis undwithin monitor in easier to reset than most printed material, but during sateroids use the high brighmess of the while backingtond might cause eye slague. Most users of blackand-white mostions will probably a death their screen nortrast for a visually conflortable black-white ratio rather then corn it have up to maximum white, Newer, cur benchmarks test does provide a useful measure of the relative ability of a monitor to deliver help contrast test and graphics. The Black-White Ratio benchmark test measures foreground background contest on black-and-white monitor. A monitor with high contrast ratio between the black lettering and the brightness of the white background on a black-and-white acreen is considered more readable for text and graphics design then a monitor with a low blackwhite asso. Accordingly, the religher bars in the chair indicate

greater readability.

Each morbitor is adjusted to give the same bore needed.

Each morbitor is adjusted to the screen bore needed of the screen as measured to a Schemo Day, Sophic light meter held to the glane surface of a Schemo Day, Sophic light meter held to the glane surface of the three comes and set for read a 1-degree served of the whom the opportunity of the screen and settled to the borgerismes level of a white patich is measured and the black-white satistic acculatation based on the two readings. Although some morbitor has capacited of producing higher white readings, the morbitor has capacited of producing higher white readings, the schema capacities of producing higher white readings, the schema capacities of the superior of back-reas, which shifts (course) gays as the white level is same to back-reas, which shifts (course) gays as the white level is same to back-reas, and an advanced on the same black level.

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■ BLACK-AND-WHITE MONITORS

doesn't ring a bell." It's really a Moniterm, the most popular high-resolution monochrome display for value-added resellers (VARs).

the Moniterm monitor because it's certainly one of the best currently available. In this guise, it pushes the display's resolution to 2,880 by 720 pixels, and I can't No apologies need be made for using help wonder when some VAR will find the

true limits of this versatile display.

The monitor is advertised as a 19-inch diagonal, and that's exactly what my ruler measured. As large as that picture tube may sound, the exterior dimensions of the attractive metal enclosure are surprisingly

For such a large display area, it is also relatively light in weight. Unfortunately the level of glare from the big screen is relatively high, and a screw-in rear foot offers the only way to compensate for backlight-



ing problems. The only controls are the back-mounted brightness control and power switch. As good as the monitor is, it is some-

thing of a mixed blessing when teamed up with the ConoVision 2800 display adapter. The problem can be summed up in a single word: interlacing. Conographic achieves its high resolution by alternating the horizontal refresh lines in each pass of the video image.

SHIMMERING IMAGE While this scheme allows a sharp image, the shortpersistence phosphor of the picture tube makes DTP (more so than CAD) images shimmer considerably. It's not enough to make the monitor uncomfortable to use. but many other displays similar to this one offer comparable resolution with rocksteady displays.

More in its favor, the display adapter exhibits above-average workmanship and versatility. Based on the Motorola 68B45 controller, it comprises a full-length board with a similar-size daughtercard holding 512K of video memory and the printer interface circuitry. Although graced with a couple of wire jumpers, it is devoid of the usual DIP switches and configuration The best news about the ConoVision's



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■ BLACK-AND-WHITE MONITORS

display board is that it fully emulates the Hercules Monochrome Graphics Adapter, the only non-IBM display mode that is supported by virtually all of the major software packages.

Although it doesn't quite cover the entire display area (it measures about 151/4 inches diagonally), the display is quite legible. Besides, overly large presentations of conventional text images (for me, at least) require excessive eve/head movement to read. The ConoVision 2800's text mode. seems like a perfect compromise between size and comfort

The characters themselves are marred a bit by obvious horizontal lines between the individual pixels. A better image could be produced if the monitor's additional resolution were used to create fully-formed characters.

The bottom line is that if you can tolerate the slight (but perceptible) interlace shimmer when using graphics-based programs, then the versatile utility of the ConoVision 2800 makes it eminently suitable as a high-performance, single-monitor solution for a wide variety of video applications.

CORNERSTONE TECHNOLOGY INC.

Cornerstone Vista 1600 Mass. No, I'm not referring to the religious ritual, but rather to the property that Sir Isaac Newton theorized about in the process of making a name for himself. Some objects are synonymous with ponderous mass: the earth, the OE2, and latefifties Cadillacs (those with hillboard-size

tail fins). Add a new name to the list: the Cornerstone Vista 1600.

After narrowly avoiding several hemiated disks among my lumbar vertebrae wrestling the Vista 1600 up a flight of stairs, I unpacked it to find a monitor of only average physical dimensions for 19inch displays. Smaller than the 20 inch Thomson and larger than the 19-inch ConoVision, it is far heavier than either of these rivals. It tipped my parcel scale at a whopping 56 pounds.

Part of this is the result of the doubleconstruction cabinet. In its quest to suppress radio frequency (RF) interference. Cornerstone has one perforated box within another. Despite these heroic efforts, the | you're well advised to do likewise. \$2,395 Vista 1600 carries only FCC Class A certification, making it suitable for use only in office environments. This isn't likely to be a problem, because the high cost alone of all of these monitors will ensure that few will make it into the average

home. The manual advises placing the monitor on a sturdy desk or table. I'll add one more caveat: don't place a PC between it and that desk. I wasn't willing to risk my AT to find out whether its case was strong enough to withstand the burden, and

Leaden weight aside, the Vista 1600's display image leaves little to be desired. Having an actual 181/4-inch diagonal, the large screen makes the best use of the graphics-based software for which it was designed. Its 1,600-by 1,280-pixel resolution produces razor-sharp AutoCAD images, and the contrast level is exceptionally high.

IMAGE REMAINS SHARP Linear distortion is conspicuously absent, and the image remains sharp right to the corners.





The Cornerstone Vista 1600's 181/e-inch screen gives you a razor-sharp image for AutoCAD, PageMaker, and other graphics applications. CGA and MDA emulation make it great for normal applications too.

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■ BLACK-AND-WHITE MONITORS

PageMaker and Ventura Deskton Publisher aficionados will appreciate the flickerfree noninterlaced display, as well as the way the video image updates with considcrable alacrity.



LE 452 ON RE

With such a vast display area and high resolution, displaying two full pages of DTP text won't send you hunting for a pair of bifocals. For normal applications, the ability to function in both CGA and MDA modes makes the Vista an excellent choice as the principal monitor on your system. Frankly, the sharp, fully-formed (albeit boxy) characters will quickly spoil you. and you're not likely to miss having color for a minute.

In either conventional mode, the image consists of a centrally located 13-inch (diagonal) image. The display's only negative point is the high level of glare from background lighting that has become the norm for paper-white monitors. A novel rear foot on the cabinet (a rectangular plastic block with an eccentrically located pivot point) allows only a very limited amount of tilt to alleviate the glare-not really enough to be of much help.

The Motorola 6845-based controller

board is a model of clean design, and it is partly responsible for the Vista's fine performance. Exploiting the full 16-bit bus structure on the AT helps explain the fast video image updating. For PCs and XTs, the board automatically switches for their smaller (and slightly slower) 8-bit bus.

OUTSTANDING CONSTRUCTION Construction quality is outstanding, with all components on the mistake-free motherboard firmly soldered into place. A smaller daughtercard is also soldered onto the main board, and it is populated entirely with surface-mounted devices. A single bank of eight jumpers is used to configure the emulation mode and to determine whether a second monitor is used on the same CPU.

Software drivers are supplied for Auto-CAD, Microsoft Windows, GEM, and Ventura Desktop Publisher, Sadly, a driver to use the increased resolution with

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1-2-3 wasn't available, but given the brilliant image running under Windows, I would be tempted to suggest a copy of Microsoft Excel instead.

The documentation supplied with the review unit was certainly among the best. It strikes a good compromise between technical thoroughness and simplicity. The one flaw was in the instructions for the installation program, which has been updated more recently than the manual. The instructions call for running VIPREP, but the latest version has been renamed to PGPREP

Through its excellent video image with graphics-based programs and its ability to handle everyday text applications with anlomb, the Cornerstone Vista 1600 is one of the better paper-white monitors around. Just be sure to enlist the help of a friend who looks like Arnold Schwarzenegger to help you get it out of the box and onto your desk.

MICRO DISPLAY SYSTEMS INC. MDS Genius

Micro Display Systems' \$1,795 portraitformat monitor, the MDS Genius, exhibits the polish one would expect given its 2 years of maturity (an eternity for these products). MDS claims that the Genius is compatible with over 150 major software packages, and, while we didn't have an opportunity to try every one, it did perform well with those we ran.

The monitor housing itself is roughly cubic in shape, and the beige plastic case seems somewhat larger than it needs to be. On the front panel are controls for both brightness and contrast; curiously missing is a power switch. Instead, the permanently attached 3-foot power cord on the back is intended to be plugged into the PC's accessory power plug on the back of its pow-

er supply. The monitor's base has a limited

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amount of adjustment available for tilt, but not for swivel. The limits of travel are really not enough to be significant, and it wasn't particularly helpful in eliminating background glare from the shiny display.



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FACT FILE

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Requires: Full-length slot, DOS 2.1 or later In Short: The oldest (at 2 years) portraitformat monitor, and the one with the most support for DTP and conventional programs.

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The veteron MDS Genius portrait momitor has accrued an impressive set of drivers and claims support for over 150 application

programs, Its 8- by 10%-inch screen area offers a flickerfree nonnuterlaced image.

The Genius is advertised as having a true 81/2- by 11-inch display area, but a ruler proved this figure to be a bit inflated. In real life, the display measures 8 by 10% inches, with a diagonal measurement of 13 inches. That may not seem significant, but with 66 lines of characters on the screen those plagued by myopia will be quickly reminded of how long it's been since their last eve exam.

Fortunately, the standard serif character set, similar to that of the IBM MDA adapter, is legible despite its size. Furthermore, the noninterlaced image, with its 60-kHz refresh rate, is entirely flicker-free.

The maximum contrast and brightness levels of which the Genius is capable seemed to be lower than those of many other monitors. Consequently, when the brightness level was turned up relatively high, the black background became a rather washed-out gray. Nonetheless, image quality remained sharp to the corners, and no linear distortion or character smearing

The image was particularly gratifying

while running Windows applications like PageMaker. Here, the black text on a white background was especially crisp and

legible. Software support is certainly one of the Genius's strongest points, with drivers supplied for not just Windows applications, but also GEM and HALO. Also, the manual provides instructions for modifying several popular programs to take advantage of the 66-line capabilities of this monitor. Among them are WordPerfect. XvWrite III Plus, WordStar (Versions 2.4 through 3.4), WordStar 2000 and 2000 Plus, Volkswriter, Lotus's Symphony and 1-2-3. MultiPlan, and Borland's Turbo Pascal, SuperKey, and Lightning.

The 1-2-3 instructions provide for two modifications, depending on your particular need. In the first, the program is changed to allow the display of 66 rows of spreadsheet cells in strictly text mode (as it would appear on an MDA display). In the second, the program can be modified to allow one half of the screen to display 25 rows of cells, while the other acts as a CGA-compatible display of graphics images on the same screen.

Unfortunately, these program patches are not made automatically from a menu but rather by using DEBUG, that powerful vet potentially dangerous program on your DOS disk that allows changes to be made to executable code at the byte level. The instructions are quite complete, but definitely not for novices. Never attempt to make modifications on the original disks-only on backup copies.

CAN WASTE DISPLAY AREA For programs not specifically adaptable to the 66line mode of the Genius, the system also emulates IBM MDA or CGA monitors. but much of the display area is wasted. A device driver (VHR_ANSI.SYS), installed from the CONFIG SYS file allows all 66 lines to be available to DOS, but not to most unsupported programs.

A utility program, VHR, COM, allows selection of cursor style, display mode, and more. It can be invoked from within the AUTOEXEC.BAT file or from the DOS command line.

Rounding out the package is the display adapter, and the board design group can take pride in the fact that, even in revision, it lacks any wire jumpers or cut tracings. Devoid of a video coprocessor, it relies in-

stead on the host CPU for display activity. The full-length board has a two-thirdslength daughtercard attached by seven single in-line pin (SIP) headers. The 8-bit bus tab works perfectly in PC and XT CPUs, but the lack of automatic switching precludes its use in any slots but numbers I and 7 in an AT. Be warned before plugging the adapter into an older PC, however, because it requires 15 watts of power from the CPU's power supply. If you still have an original 65-watt supply, you may be in for trouble. If you can afford this display system, you should also be able to af-

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Scanning System.

ford to upgrade to a 1,350-watt XT-style power supply

The MDS Genius may be the oldest portrait monitor reviewed here. Because of the software it supports, however, this maturity is an asset.

MONITERM CORP. Moniterm Viking I Moniterm Viking Portrait

Moniterm covers all the monochrome monitor bases by offering three styles of paper-white display; a 19-inch landscape unit, a 19-inch portrait, and a 24-inch landscape version. The one you choose will depend on the type of application you intend to use.

VIKING I Moniterm has to be proud of this monitor. After all, the Viking I appears in these tests under not only the Moniterm name, but under those of two valueadded resellers as well: Sigma and Conographic. Something of a chameleon, the Viking I assumes whatever character is bestowed upon it by the different controller boards and software.

Advertised as 19-inch diagonal, the \$2,395 Viking I is one of the few displays that measures up to its maker's claim. And despite its size, its cabinet is surprisingly compact. In fact, it is only slightly larger than that of most 15-inch monitors. However, if for some reason you need a bigger landscape monitor still. Moniterm also offers the Viking I in a 24-inch version.

The front plastic bezel is only slightly larger than the picture tube itself. The balance of the cabinet is made of beige-colored stamped steel, probably in the interest of reducing radio-frequency (RF) emissions. Notwithstanding its metal construction, the Viking I is comparatively light at 35 pounds-a far cry from the 56-pound ConoVision.

The brightness control knob is rather inconveniently located on the back of the case along with the power switch. For the latter, however, there is a good reason: the controller board is actually powered by the monitor rather than by the PC's power supply. Because of this, the monitor must be



The Moniterm Vikine Portrait provides a clear. well-defined display with minimal place. The utility VRIOS COM allows you to change certain monitor settings or to remove the screen from memory, freeing the computer for other applications.

with) the PC. The safest way of ensuring this (and recommended in the manual) is to leave the power switch on and control both the CPU and monitor by a power strip.

At the rear of the cabinet is a single screw-in rear foot intended to adjust the tilt angle. It really doesn't offer a great range of adjustment, but then little is needed to eliminate glare from either Viking's screen. These models are the first of their kind to incorporate magnesium fluoride coatings (the same process that gives your camera lens that curious bluish tinge). The result is a substantial reduction in glare. with no loss of sharpness that could occur with etching.

Even with a brightly illuminated window directly behind me. I found reflections off the screen to be insignificant. Moniterm's video adapter board is

unique among the products tested here in that it is the only one built around Hitachi's 63484 Advanced CRT Controller (ACRTC): the same board is used with both the landscape and portrait monitors. Construction quality of the board is above average, with the ACRTC, ROM, and powered up before (or simultaneously | programmable togic array (PAL) chips

socketed. The remaining components are soldered directly to the single full-length board

Some 40 user-selectable jumpers are mounted in eight groups on the board. Those used to select an 8- or 16-bit bus and to determine which type of conventional adapter board is coresident are well explained in the manual. The remaining iumpers, used to select the interrupt request and direct memory access, are not explained at all, and accidentally moving the wrong ones could get you in trouble.

The board's reliance on the monitor for power is probably done more out of necessity than for any other reason. During a 2boar session, it became much too hot to





The Moniterm Viking I offers a large, 19-inch diagonal display while maintaining a conveniently campact cabinet. Magnesium fluoride coatings reduce screen reflections to produce sharper images and improved viewing.

touch, presumably because of high power consumption. At any rate, it will spare you the expense of upgrading the power supply in an older PC.

in a router recommendation of the selecting the Moniteries recommendation of the compensation in mediant by decompensation in mediant by decompensation in the selection of the

ly one of the Viking I's strong points.
Of equal importance to DTP applica-

tions is that the 2,048- by 960-pixel display is not interlaced. Consequently there is no image shimmer, even with a white background. There is absolutely no linear distortion, and characters remain sharp even in the corners.

The only shortcoming of the Viking I is the unconventional way it handles standard text images. Rather than emulating a standard video mode, it uses circuitry (which Moniterm refers to as the "frame grabber") to intercept the output of a conventional display board, digitize it, and

then display that image on the Viking I.

A 12-inch jumper cable routes the output of the other board (either CGA, MDA,

or Hercules) to an input connector on the Monitemp board's back strap. It works best with the Hercules board, with the resulting image occuping about two-thirds of the screen, but using it with a CGA board results in a display area of only 7% inches at the top center of the screen. Yes, the characters are sharp and contrasty, but they're too small to read without moving uncomfortably close to the monitor.

Although that is the preferred method of running conventional programs on standard PCs, there is another alternative for owners of ATs the "software frame graber." Part of a RAM-resident video BIOS contine (VBIOS.COM), it replaces the standard video interrupt routine to allow screen updates directly to the Video streetly desplay, in the process, it also doubles the unmber of pixels illuminated by each character, resulting in an image that fills almost the entire display area. The processor



Moniterm Corp. 5740 Green Circle Dr. Minnetonka, MN 55343

Minnetonka, MN 5534 (612) 935-4151 Moniterm Viking I

List Price: \$2,395 Requires: 512K RAM; hard disk; full-length slor; CGA, MDA, or Hercules video board; DOS 2.1 or later.

In Short: The landscape monitor of choice for the value-added-reseller market, it is supprisingly compact for its 19-inch display. New software greatly improves its ability to handle standard DOS applications, but the processor overhead that this entails is best tolerated on AT-class machines.

Moniterm Viking

Moniterm Viking Portrait List Price: \$2,595

Requires: 512K RAM; hard disk; full-length slot; MDA or Hercules video board; DOS 2.1

In Short: The portrait monitor finally grows up to useful proportions. Operation with conventional DOS applications is still not as good as it is with its landscape counterpart, but the increased display size is better than its smaller competitors. For desktop publishing, it's hard to beat.

overhead required by VBIOS slows the speed at which the video display is updated somewhat, but it was certainly acceptable running on an 8-MHz AT.

Owners of older 4.77-MHz PCs are dis-

couraged from using VBIOS unless they really need its features, as the additional overhead slows most programs on those systems to a crawl.

VBIOS.COM also has software

switches that allow you to reverse the screen to a black-on-white image, select a block or underscore cursor, and remove the screen from memory when not needed. This last option may be useful when using memory-demanding programs or more than one RAM-resident program because the landscape version uses up 61K of memory for itself

memory for itself.

Software drivers are included with the Viking I for Microsoft Windows, GEM, AutoCAD, Ventura Desktop Publisher, PageMaker, Louis 1-2-3, and Symphony. The 1-2-3 drivers ensure extended spreadsheet display capabilities (134 columns by 68 rows) as well as sharper graphics. A disk of assembly-language programmer's tools is also supplied should you care to write drivers for other applications.

WordPerfect users will be pleased to know that, between that program's setup options and VBIOS, they can display screens measuring 160 columns by 60 lines with no additional driver.

VIKING PORTRAIT Now take what appears to be the same monitor, tip it over on one side, and the result is the Viking Portrait. Much larger than other portrait monitors, it offers legibility others can't match. Aside from the feet, it seems nearly identical to the Viking I.

Like the Viking I, the Viking Portrait has a magnesium-fluoride-coated screen that reduces glare to minimal levels with no reduction in sharpness. The nonglare coating is more important in the portrait monitor than the landscape since no provision is made for tilting the display, the rear feet being permanently fixed.

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Start up Microsoft Windows, and the Viking Portrait really comes alive. With a resolution of 960 by 2,044 pixels and no



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THE QUALITY GOES IN BEFORE THE NAME GOES ON

interlacing, the display is crystal sharp and exquisitely legible.

Software support for the Viking Portrait is currently limited to Windows 1.0, Page-Maker, GEM, and Venture Publisher, was abrief look as the actor opt of the new installation program shows that more are on the way. That installation menu also had entries for Microsoft Windows 2.0, Auto-CAD, Lotto 1-2-3, Microsoft Word Portrait of the Control of the

Moniterm certainly makes one of the most versatile monitors around, and its Vi-king I system is more than up to the rigors of CAD and DTP. The addition of a low-glare screen along with VBIOS greatly enhances its utility for standard DOS programs as well. Tipped over on its side to produce the Viking Portrait, the result is a stunning portrait display.

NEC HOME ELECTRONICS

(USA) INC. NEC MonoGraph NEC MultiSync GS

Until recently, there have been two basic choices in monochrome monitor display formats: portrait versus landscape. Now a third alternative is offered in the Mono-Graph—the perfectly square display.

NEC gets the honors for having had the misglit to build one, and, if my first impressions of the \$1,995 MonoGraph are any indication, they had better start beefing up production-line capacity right wavay. Simply put, the MonoGraph excelled at desktop publishing; and, with conventional applications (particularly word processing), every other monitor!

The square format at first appears to be a compromise between the two more wisdly accepted images, but in operation it in operation it in operation it in more cloosly minics a landscape format than a portrait. Consequently, standard applications are still limited to the standard 25 lines of feat, but with an important difference: nather than stretch the entire video image along the vertical axis (characters and all), the MonoCraph's CGA emulation mode keeps the aspect ratio of the characters the same as that of a conventional CGA board and puts the additional space between text lines. Hence, the text displayed using programs like WordStar is considerably more legible than on any conventional display, from CGA to VGA.

Further enhancing the image with standard programs is the pleasing character set produced in CGA mode. The additional resolution of the display has been used to produce fully-formed characters that.

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■ BLACK-AND-WHITE MONITORS



The square-forma NEC MonoGraph lacks drivers for AutoCAD and Lotus 1-2-3, but its distortion-free image makes it a pleasure to use with desktop publishing programs and conventional applications like word processing.

frankly, are among the few that I would gladly stare at all day long. Also, unlike a standard CGA display, there is no flickering when scrolling through a directory or text display. CGA graphics images are nearly as pleasing as text mode, and all color graphics are faithfully rendered in a broad spectrum of gray shades.

The only negative aspect to the CGA emulator is that the display scrolls ever-soslightly slower than it would on a standard CGA board. However, that seems to be a small price to pay, indeed, for otherwise outstanding performance.

But that's just the beginning. Start up Ventura Desktop Publisher or an application that runs under Microsoft Windows (like PageMaker), and the MonoGraph becomes all the more desirable. The image is free of linear distortion and razor sharp from the center clear into the corners. Furthermore, the standard character set for PageMaker and Ventura is not only aesthetically pleasing but more legible than many others.

The absence of interlacing is immediately apparent, as the video image is free of shimmering. The maximum brightness level isn't quite as high as that of the Cornerstone or Princeton monitors, but it is certainly more than adequate. Even with the brightness control cranked all the way | MonoGraph's outstanding performance

up, the contrast level remains gratifyingly high

Externally, the MonoGraph is every bit as pleasing as its screen image. The stylish plastic enclosure surrounds a picture tube that measures 141/4 inches, somewhat smaller than the advertised 16-inch diagonal measurement. The power switch and brightness controls on the MonoGraph are mounted on the front panel.

A tilt-and-swivel base gives the Mono-Graph a surprising range of motion, but this precaution really isn't needed to eliminate background glare; the finely etched screen is second only to the Amdek's in ensuring a glare-free image in even the

worst lighting environments. Of course, much of the credit for the

must surely go to the NEC display adapter. Based on the Intel 82786 video coprocessor running at 10 MHz, the NEC adapter can undate the entire 1.024- by 1.024pixel display area in as little as 1/20 of a second-blink and you'll miss it. Full support for the AT's 16-bit bus also contributes to the display's fast speed, but it will automatically shift to 8-bit operation when it is installed in an XT.

Construction quality of the board is every bit as good as that of the monitor. Most of the components on the single full-length board are soldered into place, with only the coprocessor, ROM, and PAL chips socketed. Three jumpers select the interrupt vector (either 3h or 5h) and determine whether another monitor (CGA or EGA) is installed on the CPU.

So what's to keep from recommending the MonoGraph to everyone? Well, there are no drivers available yet for AutoCAD or Lotus 1-2-3 (though they are under de-



NEC Home Electronics (USA) Inc. 1255 Michael Dr.

Wood Dale, IL 60191 (312) 860-9500 NEC MonoGraph

List Price: \$1,995 Requires: IBM PC-XT, AT, or 100-percent compatible; full-length slot; DOS 2.1 or later. In Short: Quite simply, the very best monochrome display available for conventional DOS applications, and an outstanding choice for DTP and Windows programs as well. If and when AutoCAD and 1-2-3 drivers (currently under development) become available,

it might well send the other man statching for my danger terms. Expensive, ves but worth every penny HACLE 600 ON READER SE

NEC MultiSync GS List Price: \$279

Requires: CGA, MDA, EGA, VGA, or Hercules Graphics video board In Short: Versatile as it may be, the Multi-Sync GS landscape monitor is clearly out of

its league among these high-resolution gi-ants. However, ensured of an exemption from planned obsolescence, it represents a reasonable choice for conventional text-mode



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KENSINGTON.







The tower-prices (AC, Stundsyne CS, Codeal with every graphices stundard, from CGA to VGA. While it's fine for everyday applications, it loses the desktop publishing and CAD battle to competitors with much higher resolutions.

velopment), and the internal cooling fan is a bit noisy. Otherwise, it is one of the best monitors I've had the pleasure to use. Since the MonoGraph was reviewed, NEC said it upgraded the monitor's hardware to improve performance and rewrote the Windows driver. All MonoGraph monitors shipped will reflect the change

MULTISYNC GS At the other extreme is NEC's new MultiSync GS monitor: at \$279, it's the least-expensive monitor (by a factor of four) that's reviewed here. As good as it may be, however, it's in way over its head in this clash of the titans.

Back in 1965, NFC was the first to make a monitor that was independent of the video display adapter's signal synchronization frequency when it introduced the original MultiSync monitor. Capable of operating with anything from a CGA to an EGA board, the MultiSync became an instant hit.

Shortly after IBM's introduction of the PS/2 (with the higher-resolution Video Graphics Array), NEC expanded its line to include the MultiSync Plus, which handles the VGA standard as well as still-higher-resolution boards. The biggest problem was that these performance increases were accommanied by higher prices as well.

That brings us to the MultiSync GS, a monochrome monitor capable of dealing with every standard display format from the original CGA to the latest YGA modes. Like the original MultiSync, all you have to do is plug it in, and the monitor automatically adjusts to the adapter's horizontal transport of the property of the property of the standard property is not a standard transport.

zontal and vertical scan rates. Hence it can deal with video images displaying a resolution as high as 720 pixels horizontally by 480 vertically.

For its tests here, the MultiSync GS was operated with both a CGA adapter (640 by 200 pixels) and a Hercules-compatible graphics adapter (at 720- by 348-pixel resolution). With either display adapter, the image used almost all of the 12½-inch screen area (significantly smaller than its advertised [4-inch size).

SLIGHT DISTORTION A slight amount of pincushion distortion (where lines along the outer edge bow in) was evident. Regardless of the brightness or contrast levels, a significant amount of fuzziness could be seen in the comers.

Externally the MultiSyne GS has been graced with a nonglare screen along with a titl-and-swivel base endowed with enough travel to eliminate even the worst glare from background lights. It also has a control panel that can best be described as accessible but delicate. The top-mounted power switch is recessed to prevent accidental operation, but the controls for brightness, contrast, vertical size, and hor-brightness, contrast, vertical size, and hor-

 NEC's MultiSync GS, overall, is a delightful monochrome monitor for conventional IBM-standard monitor applications.

izontal and vertical image position—a series of diminutive knobs—are mounted beneath a door with a plastic hinge that looks like it could break if opened often.

NEC's MultiSync GS, overall, is a delightful monochrome monitor for conventional IBM-standard monitor applications. Starked up as it was against displays with as much as six times its display resolution, however, its bargain price became all too visible.



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PRINCETON GRAPHIC SYSTEMS Princeton LM-300 Princeton LM-301

The majority of paper-white monochrome monitor manufacturers tend to make a choice between nortrait- or landscape-format displays and tout their product as the greatest invention since the automatic transmission.

Not Princeton: it offers both formats. and the technical specifications hint at the true nature of the products. Both the LM-300 (portrait) and the LM-301 (landscape) monitors yield resolutions of 1,664 by 1,200 pixels, but along different axes. While otherwise similar from the engineer's standpoint, from our perspective they are more like fratemal twins: you can see the family resemblance, but each one also has its own unique appearance and personality.

LM-300 Princeton's LM-300 is clearly the twin that inherited the Y chromosome:





The Princeton LM-300 portrait monitor's screen has the same dimensions as a standard printed page, a boon for deskton publishing users Software drivers are limited to Windows and GEM, making it best suited for use with PageMaker and Ventura Desktop Publisher

light-gray plastic housing, and the display has been oriented in portrait format. Both brightness and contrast controls are provided, located on the lower-right edge of the cabinet, and a tilt'swivel base helps

keep glare at bay. Compared to the MDS Genius, the en-

closure is particularly syelte and attractive. Although the display suffers from a smaller-than-advertised screen size (15 inches advertised vs. 13¾ inches measured), you probably won't care because the image measures 81/2 inches by 11 inches, the same as a standard printed page. The result is a true "WYSIWYG" picture with DTP programs

On the other hand, no driver is supplied for CAD programs (which aren't particularly amenable to portrait format), and the results with normal DOS applications scrolling, but operating in that mode is (WordStar, for example), are less than thrilling. No device drivers or program patches are included to enable more than the usual 25 lines of text with these appli-

cations Even though all 66 lines are used when displaying a DOS directory, the image

isn't what you might expect. Rather than scrolling like a conventional monitor, the LM-300 writes 66 lines to the screen and then begins writing over the image from

the top (after leaving a 1-inch clear space) of the screen. A utility program is included to enable

considerably slower. Should you care to copy the screen contents to the printer, be advised that the DOS Shift-PrtSc command copies only the first 25 lines of the display, regardless of what is actually on the monitor The LM-300 has a quality image with a



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Princeton Graphic Systems' landscape paper-white monitor, the LM-301, produces high-contrast, flicker-free images and is supplied with a comprehensive set of software drivers.

low glare level and no perceived flicker. This display is high in contrast, and characters remain sharp right to the comers. Some pincushion distortion (where lines along the outer edges bow in) was present, but not enough to matter.

The display adapter that Princeton uses with the portrait monitor, the LaserPage adapter, is made for the company by New Image Technology. The single full-length board shows excellent layout design and workmanship, but the lack of a dedicated CRT controller makes it at ads slow when compared to most of the landscape display systems.

The LM-300 board has 1,200- by 1,664-pixel resolution, resulting in a density of 150 dots per inch when equipped with 512K of video memory. Additional edge-mounted RAM chips can be added to take this up to 1MB and increase the display density to 300 dots per inch, the same as with most laser printers.

Software drivers currently available for the LM-300 are limited to Microsoft Windows and GEM, making it suitable for the two best-stelling DTP programs. Page-Maker and Ventura Desktop Publisher. For those applications, this portrai-format monitor is pleasant to use. However, its lack of full-screen operation with conventional applications (especially word processors and spreadsheets) makes it less than ideal as the sole monitor on a system.

LM-301 The LM-301 is the sibling that followed the conservative path into adult-hood, which, in this instance, means land-scape format. Although it follows an old path, the conventional display layout will likely prove the more useful of the two for the majority of applications.

Like the LM-300, this model is housed in a handsome light-gray plastic enclosure, and though the display screen is fisted as a 15-inch diagonal, my ruler again shows it to measure only 13½ inches. This difference may seem small, but if someone were to make a mismeasurement of nearly 10 percent in your paycheck, you would certainly raise a stink. So much for truth in advertising.

The small display area makes DTP sessions more difficult than they could be, but image quality is certainly up to the task. As with the LM-300, glare level was perceived to be a bit below average, and the noninteriased display image was totally licker-free. No linear distortion was observed, and the characters remained clear right into the comers.

Of more importance for DTP afficionados, though, may be the extremely high contrast levels of which the LM-301 is capable. Even with the brightness contutumed up to an uncomfortably bright level, the background remained a rich black. A similar-quality image was seen when we ran a white-on-black application such as AutoCAD.

Again, both brightness and contrast controls are provided, mounted on the lower-right edge of the display housing. Six-foot video and power cables make installation to a floor-mounted CPU an easy task, and the till/swivel base helps eliminate background glare.

The display adapter (called the PG-1600 and made for Princeton by Comestone Technology) is above average in quality, using only one wire jumper. bank of eight selectable jumpers allows you to choose the emulation mode (CGA or MDA) for conventional applications and also allows coresident operation with another monitor on the system.

One small problem with the CGA and MDA emulation modes, however, is the small video image. The image utilizes only a 9½-inch area of the screen; it isn't something you would want to use very often.

The sans-serif characters are also rather boxy and generally less legible than the standard serif characters created by standard CGA and MDA boards, but then again they're more attractive.

The board is based on the Motorola 6845 graphics coprocessor chip, with excellent execution speed running unforgiving programs like AutoCAD. Part of that speed is attributable to the full support for the AT's 16-bit bus. For operation in PCs and XTs, the bus automatically adjusts for their 8-bit bus architecture.

A note of caution about the PG-1600 board: it is powered by the monitor, and power should be applied to the monitor before the CPU. I tried turning them on at the same time by means of a powerstrip with no problems.

Software drivers supplied with the LM-301 include those for AutoCAD, Microsoft Windows, GEM, and Ventura Desktop Publisher. There is also a comprehensive diagnostic program that can help you during unusual installations, or if you fail to read the setup instructions fully

Given its reasonable price and high resolution, the LM-301 should prove popular for CAD and DTP applications for those on a limited budget, but the small display area when emulating standard video modes makes it merely adequate for everyday use with conventional applications.

SIGMA DESIGNS INC.

Sigma LaserView Plus

It would seem that everyone is snapping up the Moniterm paper-white monitor in the value-added-reseller market, but in all honesty, nobody does it better than Sigma Designs. The Sigma combination of software and a versatile controller board, in fact, make the LaserView seem like an entirely new product. But since the Laser-View is actually based on a Moniterm product, I refer you to that review for a physical description. After all, we should give credit where credit is due

The original LaserView was graced with one of the highest resolutions available for the PC (1.664 by 1.200 pixels). making it perfect for CAD programs. Unfortunately, its inability to handle standard DOS text meant that a second monitor was a necessity.

THE HOTANIST Professor Rogers Returns From Peru With Discovery of Rare Plant



Since our last reviews. Sioma Desions has added MDA emulation to its LaserView Plus, extending the monitor's suitability to include everyday applications. The 19-inch screen area will please desktop publishing users.

But all that has been fixed with the \$2,395 LaserView Plus, which now emulates IBM's MDA mode; the credit for the transformation goes to Sigma's new video controller. Made up of a full-length main board with a similar-sized daughtercard attached, it generally exhibits above-average workmanship. Sadly, the board once again came with the markings sandpapered off most of the integrated circuits. It sure would be nice to know just what makes this board tick, especially since it runs so

The MDA emulator finally allows the big display to handle conventional applications like word processors and spreadsheets, and it works well enough that a sec-



Sigma LaserView Plus Sigma Designs Inc. 46501 Landing Pkwy. Fremont, CA 94538 (415) 770-0100 List Price: \$2,395 Requires: Full-length slot. DOS 2.0 or later. In Short: One of the highest-performance paper-white monitors finally gets a new controller board that can emulate IBM's MDA display. What was once a monitor sain only to DTP and CAD is now suitable for

convectional software as well CIRCLE 1295 ON READER SERVICE CARE ond monitor becomes superfluous. The characters are fully formed, high-contrast, and legible, but not quite as good of those on the NEC MonoGraph or Amdek/Wyse monitors. The image is displayed in a 14inch (diagonal) area in the center of the screen, leaving just over an inch of border all around.

DISPLAY SCROLLING The display area is updated reasonably quickly, but scrolling through a directory takes a bit of getting used to. Rather than scrolling line by line, the LaserView Plus jumps two lines at a time, no doubt in an effort to speed things up. Execution speed is further enhanced by exploiting the AT's 16-bit bus, but the board will fall back to 8-bit mode automatically when installed in a PC or XT

Of equal importance to owners of older PCs is that the board gets its power from the monitor, sparing the hassle of having to upgrade the anemic power supply on those early machines.

Where the LaserView Plus really excels is with AutoCAD. Here, the ultra-high resolution (approaching that of Sun and Apollo workstations) results in razor-sharp white lines drawn on a rich black background. Furthermore, the display is free of any linear distortion.

The desktop publishing community will no doubt appreciate the Sigma's big screen area: that 19-inch area comes in handy when designing a two-page layout. And because the display is not interlaced, there is none of the image shimmer that plagues some other monitors and is most evident on a white background.

Software drivers supplied with the LaserView Phis include Microsoft Windows, GEM, Ventura Desktop Publisher, Auto-CAI, Lottas 1-2-3, and Symphory. The Lotus drivers use only the higher resolution for displaying graphics images, and the spreadsheets themselves are limited to MDA mode. Also part of the package is a copy of Z-Soft's PC Paintbrach, with a driver for the LaserView Plus. It should be just the ticket for drawing illustrations to be incorporated into DTP layoust.

All in all, the excellent LaserView Plus display system is no longer strictly a special-purpose device, but a monitor that can handle most standard applications as well.

TAXANUSA CORP. Taxan Crystal View

Only one monitor received PC Magazine's Editor's Choice when we last examined paper-white monitors: Taxan's Crystal View. Its competitors have narrowed the gap significantly in the intervening months, but the big Taxan, though largely unchanged, need make no apologies for its performance.

The \$2,195 Crystal View's ample display screen (listed as 19 inches diagonally, but measuring a bit smaller, at 18½ inches) is enclosed in an equally immense plas-

tic case of pleasing lines. Even though its 45-pound weight caused no damage when perched alop an AT, the arrangement did look a bit flootish. A better approach would be to mount the CPU in a stand on its side be to mount the CPU in a stand on its side keyboard on the work surface. To help facilitate such an arrangement, Taxan has thoughtfully provided 6-foot video and nower cables.

A tilt-and-swivel base is incorporated into the bottom of the housing with good intent: to reduce glare from bright back-lighting common in most office environments. It helps, but an etched screen finish





The 18½-inch display of the Taxan Crystal View renders graphics-based images as crisply as any, with unusually high contrast. Image shimmering is absent, thanks to the nominterlaced design.



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MONITORS

would be most welcome, since the large display screen is particularly vulnerable to glare.

Disregarding the Crystal View's imposing physical dimensions, though, it can't help but instantly befriend CAD and DTP operators. The big screen renders graphics-based images such as these as crisply as any, with unusually high contrast. Windows graphics programs, like PageMaker, are crisp and legible over the entire display area. Image shimmer, a common problem with programs that display black text on a white background, is totally absent, thanks to the noninterlaced design.

Although the resolution is only average, at 1,280 by 960 pixels, it functions capably when displaying two full pages of text on a single screen. Not only is the image accurate in terms of the black-andwhite image expected from a laser printer, but its layout will be faithfully rendered as well.

AutoCAD users will be equally pleased with the results. In black-on-white mode, there is no smearing of the image, even in the corners. Perhaps as important, there is no visible linear distortion. Few things can be worse for a designer than to have straight lines suddenly develop the curvature of barrel staves when showing off his work to his friends.

EXCELLENT PRESENTATION The Crystal View's sharp presentation is not limited to specialized graphics software. It



Requires: 128K RAM; full-length slot; DOS In Short: Winner of last year's Editor's Choice, the Crystal View is still one of the best all-purpose paper-white monitors available. The excellent CGA emulator complements its capable performance with both CAD and DTP applications. ORGIF SAS ON READER SERVICE CAL

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works with similar finesse with ordinary DOS applications as well. The only emilation mode supported is the familiar COA mode, but that seems more than adequate. Large, legible characters are displayed to from any word processor or spreadsheet with all of the light countries their profiles and the processor of the processor o

■ The Crystal View's sharp presentation is not limited to specialized graphics software. It works with

finesse with ordinary

DOS applications.

you're someone who likes to recline in a big rocker with the keyboard on your lap,

though, it should be just about perfect. Intel's 82786 graphics coprocessor serves as the foundation for the Taxan TX-1280 graphics adapter board. That plus the single ROM chip are the only socketed components, the remaining components being firmly soldered into place. A single block off our user-selectable iumpers allows for setting the interrupt request vector. Although the board doesn't exploit the AT's 16-bit architecture (it uses only the 8bit bus structure originally intended for PCs and XTs), execution is adequately fast when running AutoCAD-a killer if ever there was one. For DTP programs, Taxan's font-caching circuitry makes it competitive with all the rest.

One warning for older PC owners: this board requires a significant amount of power from the PC's bus. 18 watts, to be exact. If you have installed anything at all in one of these CPUs (with their paltry 65-watt power source), chances are that a

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for the Los Angeles County Sports Dome. to Los Augenes County open count.
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Industry attendance figures seem to prove Turk's pow In the first two months of the year, there were 37 weeding matches held in the country. From a 57,000 seat areas in Derreet to a 3,000 seat passor college gym in Raleigh. Total intendance for the marches has been estimated to be in excess of 500,000. And it doesn't show any sign of slowing down

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CIRCLE 385 ON READER SERVICE CARD

larger power supply will be required to use the Crystal View. A similar warning is in order for owners of systems without cooling fans, like Digital Equipment's VAXmate: this board runs hot.

Software support for the Crystal View is currently adequate, but not outstanding. Drivers are supplied for AutoCAD, Microsoft Windows, GEM, and Ventura Deskton Publisher. As these displays become more popular, more drivers are sure to follow.

Exquisitely legible and allowing both standard DOS applications and graphicsbased interfaces, the Crystal View is once again an excellent selection. Some may question the lack of emulation modes other than CGA, but the truth is that virtually every program ever written supports CGA mode.

THOMSON INFORMATION SYSTEMS CORP.

Thomson 980W

The Thomsom 980W is one of the display systems we examined during our last look at paper-white monitors several months back, and the reunion was rather like driving a sports car in a snowstorm-a frustrating mixture of fun and disappointment. The good news is that image quality has noticeably improved since our last look at the monitor. The bad news is that it still has a long way to go when compared with the competition.

Given what seems to be an acre of display area, the \$2,290 980W would appear to be the ideal monitor for DTP applica-





The Thomson 980W has improved since last reviewed, but it still suffers from fuzziness and low controst. The controller, however, is excellent, with high assembly quality and blistering refresh rote.



Thomson Information Systems Corp. 5731 W Slesson Ave Culver City, CA 90230 (800) 325-0464

List Price: \$2,290

Requires: One full-length slot; DOS 2.1 or In Short: Slowly improving, the Thomson 980W has matured to the point where it is no longer an embarrassment to own. Still, per-white systems that are generally su rior are available for close to its price CRO F AM ON REACER SERVICE CAR

tions, but the quality of the image indicates otherwise. When the brightness level is turned up high enough to overcome the high background illumination in a well-lit office, the display quality deteriorates significantly. Everywhere but in the center of the screen, the characters begin to smear into the background. The result is fuzziness caused by a reduction in contrast. the resolving power of the monitor. The

Even at its best, with the contrast control set to maximum and the brightness control at about two-thirds maximum, the 980W's overall image contrast is less than that of some of its peers. Where most of the competitors produce a crisp black-onwhite image, the Thomson's contrast level is closer to that of a quality black-andwhite television set. Adequate now, perhaps, but less than dazzling.

The inability to deal adequately with high-contrast images was most notable when running PageMaker and Ventura Desktop Publisher, since their predominantly white display seems to overwhelm

situation is far better with AutoCAD, with For normal DOS applications, the display is usable but, again, disappointing. On the positive side, it fills the entire display area, and the large text characters are reasonably crise. But the characters them-

its black-on-white images

selves are composed of very sharp, boxy pixels that result in an image that is both unattractive and somewhat difficult to read.

Physically, the display is quite handsome, although it is beset by all the bulk and weight that one would expect in a monitor with such a prodigious display screen. The largely metal cobinet is one of the few with a power switch convention and the few with a power switch convention to the few with a power switch convention to a power switch on the power switch mounted near the front (most seem to prefer the back, for unknown reasons) as above the power switch are the contrastable of the power switch are the contrastable of the power switch are the contrastshable for both tilt and swivel, helps overcome the relative which had pare level.

IMPRESSIVE DISPLAY ADAPTER While the monitor's performance is rather lackluster, the same cannot be said of the display adapter. Quite simply put, it is a technological standout and little less than a

■ Thomson has made a great effort toward improving the 980W, and, to a limited extent, it has succeeded.

work of art. Driven by a Texas Instruments 34010 graphics coprocessor, it is capable of updating the screen at a blistering pace. This speed is further enhanced by the ATcompatible 16-bit bus, although the unit will automatically fall back to 8-bit mode when installed in a PC or XT.

Built almost entirely of surface-mounteducies, the board's assembly quality is second to none. Eleven DIP switches and a conventional slide switch (used to select the type of monitor attached to the board) are positioned along the top edge of the board, allowing them to be changed without removing the board from the CPU.

Thomson's video board (they call it the Advanced Graphics Controller) will be of even greater interest to those who prefer to change monitors depending on application (Flight Simulator doesn't cut it on any



- Amdek Monitor/1280 and Wyse WY-700
- Moniterm Viking Portrait
 NEC MonoGraph
 - VEC MonoGraph
- Sigma LaserView Plus
 Taxan Crystal View

Which paper-white monitor is best turns out to be heavily dependent on the application you'll ase most. In this collection of nonstandard video modes, each has its own niche.

For desktop publishing afficionados, NEC's MonoGraph is an outstanding choice. Its exquisitely legible display of conventional applications like word processors and spreadsheets makes it one of the best choices for an all-purpose montion system, too.

AutoCAD owners, on the other hand, are likely to be more concerned with precise videor representation of their line drawings, and, for this purpose, the Sigma Laser-Vice Plan is superior. With a caselation of 1.664 by 1.200 pixels, it is rivals unitic comparter-based workstations in image quality. The newfound MDA-node emadation fluidly gives it the ability to serve as the principal disobs serve as the

Taxan's Crystal View was the sole recipient of oar Editor's Choice the lust time around, and even though the competition has gotten tougher, it remains an excellent allaround selection. DTP, CAD, and normal applications are all handled with appoints.

For pure bung for the back, however, the Anadek Monitor (128) (along with its identical livin, the Wyse WY-700) is bard to beat. With drivers for AutsCAD, Lotus 1-2-3, and the leading DTP packages 3, relatively small, interlaced display area is offset by superb CGA and MDA caudation. Add those qualities to the reasonable 5999 prieting, and the Anadek becomes the best stipping for occusional DTP and

Addinagh generally less legible (and, to some extent, less assefal) than their landscape-format counterparts, portrait-format monitors with the portrait, with its vast 19-luch low-glare display area, along with decent (and growing) software sapport, clearly out-lasses its smaller competiors.

monochrome system). In its standard configuration (the one we tested), Thomson's AGC video board emulates the IBM CGA and MDA boards, as well as the Hercules MGA board. An optional daughtercard can be attached to allow full EGA emulation as well.

The only negative aspect to the AGC board is that it is responsible for the mediocre character set when emulating a standard IBM display mode.

The latest support software still lacks drivers for Lotus 1-2-3 and Symphony, although they are listed on the box. In their place is a mail-in card for registered users to get the drivers at no cost whenever they become a reality. Otherwise, drivers are supplied for AatoCAD (Versions 2.60 and later) and Microsoft Windows.

Thomson has made a great effort toward improving the 980W, and, to a limited extent, it has succeeded. Perhaps the bigger problem for Thomson is that its competitors haven't exactly been sitting around twiddling their thumbs either, and their offerings appear to be more desirable alternatives.

Frank Bican is a contributing editor of PC Magazine.

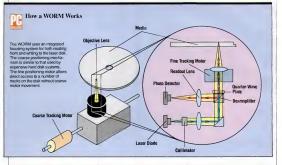


DATA STORM

THE WORM TURNS

New optical drives translate WORM technology into high-capacity data storage machines.

ontinuing advancements in mass-storage technology have probably been the most important factor in popularizing the personal computer, more so than processor power or even the ever-expanding diversity of software. After all, you wouldn't give a hoot that the magic box on your desk has a 32-bit microprocessor crunching data held in umpteen megabytes of memory if you had to type in both the program and data each time you powered it up. With the advent of the hard disk drive, the PC was transformed from a merely de-



sirable extra to an essential tool that everyone from secretaries to database application developers would rather kill for than be without. Now we have enough megabytes of storage to choke an elephant and applications that can be executed at what seems like the speed of light.

But is there really such a thing as "enough" storage capacity? Not unless you also believe there's a tooth fairy and that a lawn mower engine would work just fine in a Porsche. The disbelievers among us represent the driving force behind the advent and future success of optical storage technology. Before these optical storage systems became available, all of the older systems had one strong common bond-magnetic media. The forms ranged from tape, to floppy disk, to hard disk, to even bubble memory (which has all but faded into oblivion). The physical form each storage method took yielded a variety of compromises in capacity, speed, and reliability.

Optical storage is an entirely different beast. There is currently a choice between read-only media (commonly referred to as

CD-ROMs) and the WORM (write-once, read-mostly) drives reviewed here. (Erasable optical disk drives are still more a dream in designers' minds than a realistic device.)

WORM drives and CD-ROMs are similar only in that they use a solid-state laser to read data stored as a series of opaque pits in an otherwise reflective medialized surface on a polycarbonate substrate. The beauty of the WORM drive is that it can also be used to write to the disk, and the permanence of the media (estimated that storings. Turthermore, because the data storings. Turthermore, because the with the disk (if stays about 2 millimeters wanty from the surface), there is no chance of losing data from a head crash—the biggest fear of hard disk owners.

The optical disks used are contained in hand cases protected by sliding metal shutters, not unlike overgrown 3½-inch floppy disks. And like floppy disks, the medium can be recorded on both sides, but it has to be physically removed and flipped over to de this. Although it's relatively inexpendent

sive to add a second read/write head to a floppy disk drive to allow operation with either recording surface simultaneously, adding a second optical assembly to a WORM drive would raise that medium's already high prices through the roof.

Speed of operation, particularly when reading stored flies, is an important consideration when using WORM drives. Their predigious storage capacity is offitel use if it takes all day to search for a particular database record. Slower perior mance when writing is less of a problem because if your te pudating the files on a WORM drive very often, you're using the wring storage dwice. Remember, there's no way to recover the space occupied by bookself file versions on a WORM drives.

DRIVE ARCHITECTURE One factor that determines the data throughput capabilities of a WORM drive is the storage architecture used. All but one of the drives reviewed here uses sequential file storage. This arrangement most closely resembles magnetic tape in that when a file is updated, the old version is flargard as obsolete.

and a new file is written at another location on the disk. No file allocation table, as found on a conventional magnetic disk, exists on the ontical disk, but rather it is simulated in memory by the device driver. Like tape drives, sequential disks require a Mount command to read the disk information into memory before it can be addressed. This may be transparent to the operator, or part of an installation utility. In general, sequential storage drives are quickest at file retrieval

The other storage technology uses linked files, the system used by the Optotech 5984 reviewed here. The first time a file is written to a linked file disk, it is recorded in sequential fashion, but space is left between each data block for a pointer to a new data block, should one be written. This approach more closely imitates the way DOS stores files on a magnetic disk, and it uses space more efficiently than sequential file disks. On the other hand, linked files that have been undated reneatedly become much like a badly fragmented file on a hard disk and thus take longer to

Another factor that can greatly affect the speed at which data can be manipulated on a WORM drive is the efficiency of the device driver. This small machine-language program is installed by a DEVICE= command in the CONFIG. SYS file during the boot process. It serves as an extension to the operating system and allows the WORM drive to be accessed by conventional software.

Along with the device driver, many WORM systems also include utility programs that take advantage of the drive's unique properties. Because old file versions are never crased from the media. some WORM drives come with utilities that let you examine the contents of the older versions as well as the latest copy. Some also include programs that patch the operating system and exceed the 32MB directory size limit normally imposed by DOS. The value of such a feature on devices capable of storing as much as 400MB per side needs no explanation. Other software, depending on the package, includes COPY programs that reduce the directory space taken on the precious write-once medium, sophisticated routines for searching through data files, and pro-

gram routines for system integration development.

Since our last look at WORM drives (see "WORMS for Mass Storage," PC Magazine, June 23, 1987), enough time has elapsed for the technology to have matured somewhat and for any major limitations in software to have been ironed out. The five products reviewed here represent their makers' best efforts, and their operational differences are surprising, to say the least. Absent from our story is the WORM drive that IBM first announced last April: IBM declined to provide a unit for review. Tallgrass Technologies, whose drive was reviewed in our last roundup, was revising its product and did not have a model ready for evaluation. Nor did Maxtor, whose Ricoh-manufactured drive should hit the market sometime soon.

INFORMATION STORAGE INC. ISI 525 WC

Information Storage earned granddaddy status in only 2 years by being the first to deliver a 51/4-inch WORM drive to the PC marketplace. It claims to be the only company that manufactures storage products for everything from PCs to mainframe sys-

Since 1985, Information Storage has captured 60 percent of the WORM drive sales, primarily with the product reviewed here: the ISI 525 WC. At only 8 inches high by 51/4 inches wide by 31/4 inches deep, the PC-styled enclosure of the 525 WC doesn't soak up too much of that rarest of commodities-desktop real estate. On the back panel are the requisite power-cord jack and on/off switch, along with a DB-25 connector to link the drive to the controller board with the 3-foot cable supplied. The front panel has but a single button that serves both as the disk request switch (much like that found on the current crop of 31/2-inch disk drives) and as the drive activity light. Pushing the button during operation causes the drive to spin down and the optical head to park itself out of harm's way. That done, the cartridge is ejected about an inch for removal

Removing the cover from the cabinet revealed a drive that appeared to be of ex-



ISI 525 WC Information Storage In

2768 Januardi Rd Colorado Springs, CO 80506

(303) 579-0460 List Price: \$2,795

Requires: 35K RAM, one floopy disk drive. one half-length slot, DOS 3.0 or later In Short: Fast data throughput, along with complete IXXS computability, makes the ISI 525 WC a top choice for WORM drive applications. The drive assembly features highquality construction along with a program that patches DOS for partitions up to 115MB. enabline the drive to back up the most unforgiving directory structures.

CIRCLE 644 ON READER SERVICE CARD

ceptionally high quality, with a robust cast-aluminum mounting frame for the optical assembly and well-thought-out circuit board design. A small, switchable power supply provides the required 1 and 3 amps at 5 and 12 volts, respectively. A cooling fan draws air in through holes along the bottom front of the enclosure, but, although it should keep things cool, it could also draw in dust and dirt that could eventually contaminate the optical disk cartridge

The 525 WC connects to the PC by way of an Enhanced Small Device Interface (ESDI) controller board. At only half-slotlength, the petite board is as much at home in one of the XT's half-length slots as it is in a conventional PC. Although it performed just fine in an AT clone, the 8-bit bus structure didn't fully exploit the AT's 16-bit bus and no doubt diminished throughput somewhat from what it could have been.

Populated with a combination of verylarge-scale integrated (VLSI) components and conventional ICs and discrete components, the controller's chip count is amazingly low. In addition, it was surprisingly cool even after being powered up for several hours in an AT with the case cover removed (rendering the cooling fan useless). This signifies low power consumption and may equate to longevity. On the other hand, although the board seems reasonably well assembled, there were six wire

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ISI's \$25 WC combines exceptionally high hardware quality with sophisticated software that makes the drive easy to set up and use. The result is a system that's hard to beat.

jumpers snaking all over the place to compensate for some designer's shortsightedness. Not a pretty sight, perhaps, but in the end, it worked just fine.

A bank of eight DIP switcher seides along the upper edge of the board to select the operating mode and port address. One switch selects direct memory access (DMA) mode for use in either a FC or KT, the same switch in another position selects the Programmed Input/Output (POI) mode preferred when the 525 WC is installed in an AT. The other switches control which group of eight consiguous port addresses the programmed of the control with the contr

Unfortunately, the manual doesn't specify which drivies could cause problems, nor which address alternatives should be used in the event of a conflict. I guess if you can afford an optical disk drive, you are also expected to foot the expense and incommentation of a long-distance phone call to make it work on your particular system make it work on your particular system. In all fairness, the documentation we received with the review unit was a beat copy, and we hope the release issue will correct this lack of detail.

WORM-TOS Software—that commodity that can make or break a WORM drive—is definitely one of the 525 WC's strong points. ISI refers to its device driver and DOS extensions as WORM-TOS. That name immediately conjured up im-

ages of mixed-annelid salads or perhaps pervence carnival games in my mind, but its performance is nothing to be laughed at. Although the "VORN" portion of the name is self-evident, the "TOS" customtons stands for "Tonssperated Opticated Son ware," and it lives up to its name in proceeding the properties of the properties of the properties of the properties of the protable of the prota

other manufacturers can't make.

The 525 WC managed to handle all of
the performance test programs—and in the
fastest time of any WORM drive. The execution times were only about 50 percent
longer than those experienced on the 40millisecond AT hard disk, and it even digested the massive XCOPY directory
backup test without a hitch.

A couple of utility programs specific to the 525 WC are included on the WORM-TOS diskette. NO32 makes a patch to DOS to eliminate the 32MB restriction for disk drives. (No program is supplied in case you have to return your installed copy of DOS to its normal status, but booting an unaltered copy of DOS from the floppy disk drive and typing SYS c: restored things to normal without problem.) With the patch in place, the normal sector size is increased to 2,048 bytes, as opposed to the 512 bytes normally used. The penalty for this is the loss of 30K of available memory when both are used with 20 buffers, a relatively standard configuration. The Disk Partition Utility (DPU) is used to initialize a new optical disk cartridge, alter the existing disk partitions, and toggle various device driver flags. Think long and hard before running this program, because you could all too easily turn the data stored on it to rubhish

The Back Track Utility (BTU) gives you the ability to find and read older versions of files previously stored on the 525 WC and later updated. Unlike magnetic media, WCDMS don't write over older file versions when a new file is stored with the same name. WBACK, the backup utility, operates in a novel and not altogether successful fashion. When run, it examines the source drive for the directory structure and files to be backed up, and then generates a batch file to accomplish the task. In the use of a drive containing the XCDVPY performance test (3,156 files in 1,379 directories), the result yielded a batch file 478K tytes long. The only problem, though, puthamne exceeded 66 characters. One quently, the lowest seventh/directory teresulted in "Invalid Directory, Unable to Create Directory" error messages on the secreen, and the files in them were not backed up. A better alternative is to Days Communication.

The ISI 525 WC is certainly one of the more well-honed WORM drives available, and ISI's WORM-TOS device driver is among the best there is. If you really believe that optical storage is the path toward the future, then the 525 WC is a big step in the right direction.

MAXIMUM STORAGE INC.

Maximum Storage APX-3000

Open up the bood of the Maximum Storage APX-3000 and you'll find . . . well, frankly, a rather familiar product. Although the sticker on the drive assembly reflects the name of its marketer, the inscription on the controller board (Information Storage Inc.) gives its heritage away. Only the front bezel has been changed to protect the innocent.

Maximum Storage's APX-3000 is one of a growing number of PC products mar-



CLI 658 NURS ADVENTAGE

keted by value-added resellers (VARs). They purchase the nuts and bolts from someone else and then add their own special features (software, in this case), and market the product under their own labels. VAR products often fill specialized niches much better than their original manufacturers' counterparts. Would that I could say the same for the APX-3000. The hardware for the APX-3000, already described

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CIRCLE 337 ON READER SERVICE CARD



The APX-3000 from Maximum Storage is a relabeled version of the ISI 525 WC. While the hardware is beyond reproach, the setup and utility software for this drive need improvement.

in the review of the ISI 525 WC, leaves little to be desired. Construction quality is excellent, forgiving the ESDI (Enhanced Small Device Interface) board's wire jumpers.

Junior Afficience between the APX, 3000 and its sibling is the software, and its sibling is the software, and its sibling is the software, which proved to be the downfall of the relabeled to the work of the sibling of the sibling of the divide the unit is enough to get the drive up and the unit is enough to get the drive up and performance of the device driver leaves a tot to be desired. AMXSYS_EEF functions as the command processor and optical file manager, while MAXSBOS_COM serves as the low-level device driver called from the CONFIGE_SYS_file on the boost form the CONFIGE_SYS_file on the boost form the CONFIGE_SYS_file.

drive, either a floppy or hard disk. (The optical drive cannot serve as the boot drive.) Should you not have a CON-FIG.SYS file on your boot disk, you can use the version supplied on the MAXSYS-DOS floppy disk.

DOS floppy disk.
An Install batch MAXYS-1005 programs from the floppy disk to your had disk in a new directory called MAXYS-1105 programs from the floppy disk to your had disk in a new directory called MAXSYS.
If no CONFIG.SYS file is found, the version on the MAXSYS-DOS disk can be copied to the root directory. If one slicesty to the confidence of the

.EXE, which serves to initialize a new optical disk cartridge. It will also add a description label to the cartridge up to six lines in length. This is in addition to the DOS volume label, which DOS limits to 11 characters.

SLOW THROUGHPUT Data throughnut may be the most important performance consideration with a WORM drive. and MAXSYS-DOS is slow. The APX-3000 drive took over 15 minutes to copy a 10MB file from an AT hard disk and over 19 minutes to copy the file back to the hard disk. Worse still was the FIND performance test, which took nearly a half-hour to search for a nonexistent string in that 10MB file. So much for scanning large databases on the APX-3000! The XCOPY performance test failed after creating only 147 directories with two files in each. At that point, the system crashed and could be restarted only by turning the computer off and then back on again.

Maximum Storage claims that MAXSYS-DOS will work with up to 20 subdirectory levels and that the number of files is limited to available disk space. That may be so if they are copied one at a time. Just don't try to back up a complex hard disk directory structure using XCOPY.

MAXSYS-DOS is only partially compatible with MS-DOS commands, supporting only the more obvious commands like COPY, FIND, APPEND, TYPE, XCOPY (supposedly), and so on. Several important commands such as BACKUP,

 The hardware used in the APX-3000 has proved itself well made and capable of

very good performance.

RESTORE, and TREE are not supported. Others, like CHKDSK, DISKCOMP, and RECOVER, are listed in the documentation as meaningless for an optical drive and hence incompatible.



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Summary of Features (Products issled in ascending price order)		TT .			
	ISI 525 WC S2,795	N Hance 525 Optical Disk System \$2,950	Optolech 5984 \$2,950	Maximum Storage APX-3200 \$3,495	Micro Design Laser Bank 800 \$9,995
Capecity (per cartridge eide)	122MB	120MB	200MB	122MB	400MB
Dimensions (HWD in inches)	8 × 5½ × 3½	51/4 × 7 × 151/4	51/4 × 71/4 × 161/2	51/4 × 61/4 × 151/2	61/4 × 10 × 17
Cartridge price	\$95 (single sided) \$135 (double sided)	\$95 (single sided) \$135 (double sided)	\$65 (single sided) \$125 (double sided)	\$125 (single sided) \$175 (double sided)	\$150 (double sided)
DOS support	Full	Full	Full	Fut	Full
Herd-pliek megnetic buffer	0	0	0	0	•
Support softwere	Device driver, development tools, Xeriax, ISI DOS, interface libranes	Device driver, text search	Development tools, C-language interface, low-level language interface, diagnostic software	Device driver only	Device driver only
Interfece type	ESDI, SCSI	ESDI-like	Optotech proprietary	ESDI	SCSI
File erchitecture	Secuental	Sequential	Linked	Lipked	Sequential

The documentation supplied with the review unit was quite comprehensive and understandable, even in draft form. A substantial number of drawings make installation of both hardware and software a simple task in most any MS-DOS machine. The hardware used in the APK-3000 has arrively proved itself (under different la-bels) well made and capable of very good public, however, hong it to its knees, resulting in exerucialingly slow data throughput.

MICRO DESIGN INTERNATIONAL INC.

Micro Design LaserBank 800

There's an old adage that an elephant never forgets, and that seems like an entirely appropriate description of Micro Design International's LaserBank 800. Not only is it gigantic in physical proportions and storage capacity, but it was also one of only three drives to execute all of the performance.

mance test programs successfully.

At 61/4 inches by 10 inches by 17 inches, the Micro Design LaserBank 800 is

nearly as large as some of the small-footprint AT compatibles it's likely to be connected to. The 22-pound hulk is something you won't want to move about very often, but given its gargantuan capacity of 400MB per disk side, the LaserBank's

weight doesn't seem unreasonable. Removing the top cover revealed some surprises. The first was that much of the unit's weight comes from an incredibly robust chassis: it could probably serve double-duty as a wheel chock for an earth mover. The second surprise was the beautifully put together optical disk drive assembly, labeled Maxtor on the back but Ricoh on the circuit boards. Never mind who really manufactures it, it's truly a jewel. By taking advantage of very-largescale integrated (VLSI) circuitry, the designers have created boards that are remarkably sparsely populated for a system with such a high storage capacity. This board's design is nothing short of a work of art-well thought out and obviously the product of quality assembly. The biggest surprise was just below the optical drive: a 25MB 31/2-inch hard disk drive that serves as a scratch pad for the device driver and cannot be addressed directly from DOS.

Other noteworthy features within the cabinet include a power supply fully encased within a perforated metal cover and a radio-frequency (RF) interference filter on the power line. The front panel is graced with a total of four power switches: one for the drive itself and three for the AC power receptacles on the rear panel. Small potatoes, perhaps, but this design should result in a neater installation than the usual power

strip on the floor.

For the controller board, Micro Design chose to use a Small Computer System Interface (SCSI) adapter manufactured by Padgett Nelson Industries. Its half-slot length enables its use in the short slot of an XT. The component layout is neat, but if



strous directory structure with aplomb.
ORCLE 657 ON READER SERVICE CARD.

ERASE. ARE YOU SURE?

Every computer user faces this question in some form each day. To ense or not to erase. To save or not to save, when saving means overwriting the previous version of a file. If you answer yes and you're wrong, countless hours of work will be wiped out by a single keystroke! And there won't be anything you can do about it, unless you're backed us.

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inep is just a reystroce away.

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cause the typical bs every 8.5 minutes.

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437-4329, extension 294*

If you work on more than one thing at a time, it only makes sense to work with the software that works the same way you do.



Corporation; WordStar/MicroPro International Corporation. Prans-work II runs on the IBM*PC and 100% computables. ©1987 Ashton Tate Corporation. All rights reserved.



The LaserBank 800 stores 400MB of data per cartridge side and includes a 25MB 3½-inch disk drive. It was one of the few drives to complete our benchmark tests without problems.

agreem to have been subjected to a too hersided both. Question was fine, he many of the copyer tracings were wrinkled away of the copyer tracings were wrinkled away from the substrate. A bank of eight poly switches selects options such as SCSI host identification (in the event that more than one SCSI device is connected), direct memory access (DMA) mode, and parity. Four banks of jumpers also reside on the board, but only hose for the DMA channel selection are documented in the manual selection are documented in the manual production of the contraction of the contraction of the contraction of the production of the contraction of the production of the contraction of the specific of the contraction of the contraction

The software supplied with the Laser-Bank 800, referred to as the LaserBank Management System (or LMS) by MDI, falls in the middle of the group in terms of both performance and thoroughness. Two

floppy disks make up the package: one with the device driver software, a memory-resident disk cache program, and a menu-driven installation program; and the second containing a couple of utilities unique to the requirements of the Laser-Bank 800.

INSTALLATION An installation program copies all of the programs to the fire programs to the fire the convention of the programs to the fire the device driver) and AUTOEME. BAT file (so tun the cache program upon boxing). All of the files (15 in all) are copied to the hard disk's root directory native than being placed into a special subdirectory. Dig out your DOS manual, and you may be able to figure out how to copy the programs to a subdirectory and modify the CONFIG. SYS and AUTOEMEE. BAT

files yourself—no help is given for this in the manual. In fact, much of the manual consists of little more than snapshots of the screen during execution of various menu options, with precious little explanation of what the selection limits are.

One operational difference between the LMS device driver and DOS may make you want to edit your CONFIG.SYS file regardless of the automatic installation procedure. Each buffer increases in size by 16 times, to 8K, as opposed to DOS's 512byte size. If your system is set to boot up with 20 buffers (a fairly common number), 150K of RAM will be lost for application programs. One utility program you'll want to become intimately familiar with if you want to maximize the storage capacity of the LaserBank 800 is LCOPY. Something of an enhanced version of the DOS COPY command, its principal advantage is to reduce the space required to store information on the precious write-once media by reducing directory overhead. The 2.33 percent savings on the 10MB performance test file may not seem like much, but considered over the entire 400MB-per-side capacity of the media, that equates into a storage increase equal to 25 360K floppy disks! The only penalty is that the program takes approximately 10 percent longer to execute than its DOS equivalent.

On the arduous XCOPY performance test, the LaserBank 800 proved capable of backing up large-directory tree structures, albeit slowly. While that test generally takes about 45 minutes between two AT-

■ The LaserBank 800

handled the complicated directory structure that made some of the other drives go belly up.

class (40-millisecond) hard disks, the LaserBank 800 required 3½ hours. The bottom line, though, is that this disk worked with the complicated directory structure in which some of the others went belly up. In

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An excellent performer, the ISI 525 WC. Jumed in the lastest all-round results. The N Hance SS5 Optical Disk Systems comparable results are to be expected, either the package consists of an ISI 525 WC, since the package consists of an ISI 525 WC side and driver enhanced with test-scanning software and soid by N P Hance under it sown table. How would expect similar results from the Maximum Storage APX 2000, since it has been some similar to the proper APX 2000 uses a less sophisticated device driver, witch accounts for its slow.

The single common denominator for virtually every PC and attendent peripheral device is DOS, and several of its commands constitute e suitable leating platform for WORM driver.

The BigHile and Scatter performance tents (developed for PC Megazine by contributing elder Winn L. Bloach; more backupred designed to lest laps backup systems, and, since backupstronge in a lake; you be for WCPSI drives. They are appointed tests for historiums. Ther devices divers, however, which is the state of the state of the state of the state were written by faccurately measure data throughput at the DOS level from a hard disk faden with the fruits of these programs. Performance Times Write Read Find Xcopy min-sec (minuer) (minrage) (hr:min:sec) 191 525 WC 458 3:06 3:02 1:33:22 Maximum Storage APX-3000 27:38 15:02 19:18 N/A Micro Design LaserBank 800 8:53 4:30 3:29:57 N'Hance 525 Optical Disk System 5-02 2-06 3.02 1:33:29 Optolech 5984 5:29 5:20

N A.—Not applicable. These devices could not complete the Xcopy test. The Maximum Storage APX-9000 tailed after backing up 147 directiones, the Optotech 5964, after 166 directiones.

The Write performance test measures the time required to copy (using the ODS COPY command) a IMM8 file the result of Biglife) from a 40-millisecond AT-class hard disk to an optical disk drive. Plead does the oppose, mississing the time required to transfer the same file book to the com-

Since many (if not most) WCRM drives will be used for set strong of large treat feet. The Timed performance led is particularly appropriate Using the DOS FIND command, it searches Bigliet for a nonesistent character string, thereby simulating a typical database query.

XCDPV the CDS corrend the allows often directory structures story, with her attended Hels to be copied from one derice to another, clerks at the basis for the Xcopy performance let. The directory shincute copied in this case is the result of the formidable Scattler program 3.05 lies, couch 2.04 bytes in length, in 1.579 directories nested lies, couch 2.04 bytes in length, in 1.579 directories nested were capable of huming this lief is vaccessfully, the other hos deplied their derectory space premanality.

In the interest of learness and consistency, all of the drives were tested using 20 files and 20 buffers specified in the CONFIG SYS file.

the more mundane world of archiving single files and searching through them glo DOS, the LaserBank 800 proved to be only average in terms of the time required. If you have applications not requiring any and access times on the WORM drive but instead prefer the knowledge that the disk work immobate inset on a complete and the most immobate inset on a complete upon the most interest in the contract of the contrac

OPTOTECH INC.

Optotech 5984

Many PC products available today are designed with the philosophy that they should be trivial to install (hence menudriven installation programs), follow a standard user interface (winess the development force aimed at Microsoff Windows and like products), and be relatively transparent in operation to the user (the forte of the Macintob).

The Optotech 5984 optical disk drive

hangs tough against this momentum and may find more favor with software developers than with casual PC users simply looking for a high-capacity archival storage system. This intention is clearly evident in the software supplied with the 5984. Where most settle for a device driver and a handful of utilities, the five Optotech floppy disks are also replete with a number of subroutines for C programmers who want to endow their software with basic I/O functions, primitive functions, and error-handling routines. All are claimed to have been compiled with both Lattice C. Version 2.15, and Microsoft C, Version 4.0, but not necessarily other compilers. Two of the disks have routines that are unique to the optional SCSI (Small Computer System Interface) adapter, but the review unit came supplied with Optotech's standard PC controller.

The PC controller consists of two fulllength boards piggybacked together in an unusual fashion. Owing to the staggered nature of the PC bus tab and the backstrap, most double-board devices are nested to avoid physical conflicts with adjacent slots. Optotech's adapter, though, forgoes this available space and places the daugh-

tercard on the outside of the motherboard. As a result, you have to install it in the outermost slot in order to keep it from wasting an adjacent bus connector. Not all PC cabinets may allow this arrangement due to clearance limits, but the PC's Limited AT used for testing had no problem.

As for construction quality, the board



Optotech 5984 Optotech Inc. 770 Wooten Rd.

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In Short: The actions is library of standard.

In Short: The extensive library of standard input/output functions written in C makes the 5984 a marvelous tool for program development using the optical drive. However, the software supplied for normal DOS applications makes it all two easy to destroy the contents of the day, and the overly technical manual will be of little help to all but experienced programmers.

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The Optotech 5984 comes with a variety of development-level subroutines that should make it attractive to systems integrators looking for a WORM drive to add to their package.

set rates second only to the Coleco Adam computer for the most design flaws disguised by questionable construction practices. We're talking about things like an IC with a few legs cut off and wire jumpers looping over its back to the board tracings. Worse still is an IC with one wire jumper between two legs, a pair of resistors soldered to other legs, and a crystal soldered to the resistor leads. I can't report what type of device that IC was because the crystal was glued to its top surface. All told, there were enough cut tracings and wire jumpers (29, unless I lost count) to put it in the "alpha" test version category-something that should stay in the R&D department until revision B is made available. This is really too bad because the controller performed adequately during our limited testing and has a number of features that make it otherwise desirable.

Absent are the usual DIP switches and jumpers for configuration; instead, the 8088-based device features automatic selection and verification, error detection and correction, and double buffering.

WELL-DESIGNED ASSEMBLY The optical drive assembly is mercifully devoid of the design shortcomings of the controller. Here, construction is of exceptional quality and apparently well thought out. Installing the 5984 on a PC will acquaint you with the unusual operation of the cartridge ejection lever. A dummy cartridge, designed to protect the optical assembly during shipping, must first be removed, although the drive locks it in place with the power off. A small wire tool must be inserted into a hole on the front panel to unlock the lever, and then the lever can be swung to the eject position. The tool is diminutive and you'll probably lose it, but a bent paper clip will work just as well.

Once the drive is powered up, the cartridge eject lever can occasionally be a bit of a nuisance. First, the lever is pushed to the left, and the tricolered LED indicator flashes green while the drive slows to a halt. Once the disk stops spinning (indicated by a steady green light), the lever is moved to the right and the cartridge is ejected. Don't walk away, because after

about a minute the drive locks up, and you'll have to go through the ritual again.

On the Write, Read, and Find performance tests, the 5984 proved to be avorunace tests, the 5984 proved to be avorune to the properties, running through each program in about 55° minutes. The XCOIPY
performance test, however, found the
only 186 of the 1.59° directories, the unit
halled with a "write protect" error and the
message that "Opical memory is forested
free to the state of the transportation of the
read division." Apparently the directory
flexible file allocation table of this DOSdisk-emulating desire.

Special mention should be made of the munual supplied with the 5984. The premature failure of the file allexation table outdip robably have been prevented by specifying a different starting address for the directory, but the instructions are rather incomplete, and a casual owner won't get the faintest idea of what to do from the terse directions. Furthermore, no talley is the starting of the starting of the address of each base directory. Be prepared to waste a few disk cartridges getting at to work properly with large directory structures containing many small files. Firlandy, despite its escond revision, the man-

■ On the Write, Read, and Find performance tests, the Optotech 5984 proved to be a worthy competitor, running through each program in about 5½ minutes.

ual has more than its fair share of typographical errors.

For system integrators or software developers looking for a WORM drive to incorporate into their package, the Optotech 5984, with its variety of development-level subroutines, should prove valuable. For

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TWO SIDES OF THE SAME COIN

Optical data storage and magnetic technology may seem to have little in common. In fact, there are almost as many physical similarities as there are differences,

The cartridge shell looks rather like an overgrown 3½-inch floppy disk assembly, but the exterior dimensions have swelled to approximately 6 inches by 5½ inche. So 5½ inch. Considering that the storage capacity can be as much as 1,000 times that of the diministic floppy, the size increase seems insignificant, to say the least

More comparable in size, perhaps, are the interchangeable cartridges used in a few Winchester drives and the media found in lomega's new Beta-20 Bernoulli Box drive. Even these units still require 5 to 20 cartridges to store as much as one ontical cartridge holds.

A spring-loaded metal shutter covers the opening for the optical read/write assembly and is automatically moved to one side when the cartridge is inserted into the drive bay.

A pair of plastic latches, one on each trailing corner of the shell, is used to write-protect each side of the WORM disk assembly, should that be required.

Like magnetic disks, most WORM disks can record on both sides, but due to the high price of optical read-write heads, only one head is used in each drive. Using the second side, then, requires that the disk be removed, flipped over, and reinserted.

The disk itself is quite unlike that used on a CD-ROM drive (or a CD serve system, for that matter). The polycarbonate substrate is roughly twice as thick as that of the CD-ROM, measuring about 2 millimeters. Onto this base a thin filmeters became a continued to the rare-earth element tellurium (from their asme atomic group as sulfur and serven a summa tomic group as sulfur and serven tellurium) is deposited by a vapor-plaining process. Additional polycarbonate layers are then applied to the disk to protect the delicate recordinise surface.

The resulting film is so thin that it appears to be transparent: open the shutter, and you can look right through the media when it is illuminated by a bright light.

Like pocket-size floppy disks, optical cartridges have a metal hub, but a precisely machined one that ensures precision alignment on the drive spindle, whereas 3½-inch floppy disks can get by with stamped-metal hubs.

Anyone who was in the computer

field before the current microcomputer revolution will member that the 8-inch floppy disks used on many early mini-computers were hard-sectored. A series of holes (as opposed to the single timing hole found on current soft-sectored floppy disks), each delineating a sea sparate sector, was punched around the periphical participate and the series in lair in that the sector information is burned into the format-

ting process at the factory. Open the shut-

ter, and you'll see the sector divisions ra-

diating from the hub.

One problem with the current optical cartridges is the lack of a common standard. Although outwardly similar, the optical format and physical dimensions of each manufacture's products are significantly different from those of its competitors. Consequently, an ISI cartridge cannot be used in an Optotech drive, or vice versa.

Although single-sided cartridges are available, there seems little point in using them. The prices for single-sided media (typically around \$140) are considerably more than half the price of their double-sided counterparts (at around \$200 each).—Frank Bican

those who just want an easy-to-use, reliable mass-storage device, however, the Optotech 5984 comes up short.

SYMPHONY SYSTEMS INC.

N/Hance 525 Optical Disk System

Unpacking the N/Hance 252 Optical Disk System was rather like attending a 20-year high school reunion: you recognize the face, but you can't quite place the name. The answer isn't an identity change for a former CIA informant, but rather the relationship that exists between original equipment manufacturers and value-added resellers. In this case, the hardware and device driver software are a known quantity: the excellent ISI 525 WC optical drive and WORM-TOS operating system extension. Having already scrutinized them under that company's own label, we'll forgo another description of those products and direct you to the ISI review for details.

The value added by Symphony Systems, then, lies in the firm's TexaCostiware package. Given that most WORM dries will probably be used for permissent storage of large documents, TextScan will make the process of searching through over 115MB of data a painless task. Symphony Systems bils TextScan as a conputer, but that hardly does it justice. TextScan can also be used to filter hightocontrol characters from word processing ■ *TextScan*'s file compression can reduce storage space by as much as 50 percent.

documents, cut text from a WORM document file and save it on magnetic media, and compress text files to only half their normal size.

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ou are a business executive, consultant, engineer, or in any other profession, you nee Tornado-it will save you endless time and effort every day-guaranteed-or your money back. Here is how it works:

■ Information Windows With Tornado, you process information in stacks of superfast "intelligent" windowsseveral on your screen at once. You type into the windows; interconnect and prioritize them; and scan through them in remarkable ways.

Free Form Tornado is FREE-FORM. It works the way you think. To start a new window you just press N, and enter information. No file names No extra keystrokes. To

retrieve information you just press G (for Get), with any word or phrase—you'll watch Tornado zip through your windows like lightning linking and opening those requested You can even flip through your windows with the arrow keys and watch them instantly pile up and lift away. These are just three of 18 easy but powerful features.

■ Space Station Tornado is being used on the complex US Space Station project-but it does simple things too: When Harry calls you on the phone, in two seconds flat you'll display the six windows on Harry before he finishes his first sentence! No mo embarrassing pauses or scrambling fo information. Tornado is so versatile information. Tornado is oversative you can: write and print a letter faster than ever; track things to do; edit electronic mail; and plan a project or event—quickly and easily. You can even build a sophisticated

"knowledge" base—or an unstructured data base— without programming. And that's not all. Track phone conversations, numbers, sales leads, and all your other RANDOM information. With the new option you get: "Library" of windows containing: free-form caler project planner, grid maker, city/state/area code/tim zone translator, and much more. On a portable, Tornado is your ideal moving office. Best of all, you tailor Tornado to your own needs-easily!

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"Excellent Excellent Excellent Excellent"

"one of the niftiest ... programs I've ever seen."

BYTE, Jerry Pournelle

"Excellent value" IntoWorld, Review Board

"Editor's Choice"

"simple ... superfast" New York Times, Dimeni

can start "Tornado-ing" in 15 minutes-not 15 days. And that's a pretty good deal since Tornado can save you an hour every day!

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To reach your goals, you need tools that maximize your productivity and help you make your best decisions. Tornado fits the bill perfectly. In fact corporate user surveys show you may well use Tornado more than any other software package! Order today risk-free.

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FEATURE. Treform 4, preferred various, could ge an wide, a great A payer a file at a recovery and payer a file at a recovery and payer and a payer a file at a recovery and a payer a file at a fi



Look familiar? It's the ISI 525 WC again, this time with an NiHance label. But the changes are more than cosmetic: text scanning software adds value to this drive, making it a winner.

ers may yearn for the speed of command line processing.

The Search function of TextScan will probably be its most popular feature, and even though it takes roughly 40 percent longer than the FIND command in DOS, it is far more functional and complete.



Searches can comprise up to eight phrase fields (each up to 20 characters long) in two groups, and the field entries can be linked together with the logical operators AND, OR, NOT. While not a logical operator per se, the Proximity relationship can be used to allow only those entries to be found that coexist within a specified number of lines, from 0 to 99. Where the DOS FIND command can examine the contents of only one file at a time, Text-Scan's Search function can be set to examine the contents of up to 500 files at a single sitting. Such batching of search commands allows you to initiate a search and go have a cup of coffee while the program does your work for you. When the cup is empty. you can come back and examine the results of what would have required hours (not to mention an absurd number of keystrokes) to perform using DOS. File compression becomes particularly

attractive when storing files on a WORM drive. Remember, only a finite number of files can be placed on any WORM drive, and although the media is replaceable, at



 ISI 525 WC
 N/Hance 525 Optical Disk System

When FC Magazine first looked at WOPM drives to Lone 23 1987, they were fall of promise but short on performance. I fall of your later, at least two products have made the wait worthwhile. The ISI 525 WC, in part for its excellent drive assembly and controller the ween more so for the outstanding WOPM TCS device driver, gets undfor exception at data throughput performance. Its which, frankly, fair needed—the DOS XCOPY command can be used in its place.

Symphony Systems' N/Hance 525 Optical Disk System combines the same quality drive and device driver software from ISI with its excellent TextScan software package, resulting in a versatile text retrieval system.

prices up to \$250 per cartridge, it's not exactly cheap (see the sidebar, "Two Sides of the Same Coin").

TextScan's file compression function of can reduce stonege space by as much as 50 specent, and the resultant files are fully accessible to the Search function but not to other applications. Files that have been compressed are recognizable by their irreduced C.MP extension. Naturally, a decompresssion function is also part of the package: after files have been returned to their normal state, so is their filename extension.

The ISI optical drive with its WORM-TOS device driver software need make no apologies for its performance. When combined with Symphony Systems' excellent TextScan data retrieval software, it's even

oction.

Frank Bican is a departmental computer resources supervisor at a Cleveland medical center.

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8 expansion slots
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 8 expansion slots
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 AT type keyboard
 Multi I/O with floppy controller
(I serial port/I parallel port/I game
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battery backup • 150W power supply

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Base System

 Same as MIC 286-12 with 80286-8 CPU 0 wait state
 Landmark CPU test 10.3 MHz 512k standard RAM expandable to 1MB on board AWARD BIOS

SAMSUNG 5-286 PLUS

Base System

- * Same as MIC 286-12 with 80286-10 CPU 0 wait state
- 1MB standard RAM on board · Small foot print

SAMSUNG 88 TURBO 8MHz Base System \$559

- 8088-2 CPU 4.77/8MHz switchable speed • Phoenix BIOS • 512K RAM expandable to 640K on board
- 7 expansion slots · AT type keyboard





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моно сомво	\$120	NEC MULTISYNC II	\$549	INTEL Math co-processor 80287-10 \$290
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MAKING CONNECTIONS NORTHERN TELECOM'S MERIDIAN LANStar PC

consider ways to connect hundreds of PCs, you can quickly focus on a few solutions. Voice-and-data PBXs from companies like Mitel, AT&T, System Resource Exchange, and others can handle thousands of connections made over miles of the telephone wiring you probably already have in the walls of your buildings. But these connections typically transfer data at 19.2 kilobits per second, which is an inadequate rate for interactive PC processing applications such as sorting files in a database.

If you need more speed in your corporate network, you should certainly consider Ethernet in its many forms. Xerox, DEC, and other companies will help you install the "frozen orange garden hose" Ethernet backbone cable and the taps and transceivers As has been made clear by our ongoing connectivity series, the list of network product choices is seemingly endless. What is it, then, about

the Meridian LANStar PC that has us describing it as "the best overall corporate networking solution"?

FRANK J. DERFLER, JR.

secded to connect to it. As the cable gets longer, however, the design of the system becomes a second of the control of the co

Yet, paying for and installing Ethernet is child's play compared with the big-time investment required by that other corporate network solution: the IBM Token-Ring Network. The IBM Token-Ring system, supported by the IBM Wiring Plan, is expensive, bulky, and with its mess of cables, ugly. Both 3Com Corp. and Proteon have Token-Ring implementations that are easier to maintations that are easier to maintain but not cheaper or easier to install.

Then there's Northern Telecom's Meridian LANStar PC, which carries data for thousands of feet at a data rate of 2.56 megabits per second over twisted-pair telephone wire. The best overall corporate networking solution for PCs I've seen, the LANStar PC is particularly attractive if you need fast access for interactive processing jobs or if you have a network with many servers.

The LANStar PC offers excellent throughput. The system we tested was integrated with a Banvan DTS DeskTop Server running Banyan's VINES networking software. Our PC Labs benchmark tests reported slightly better performance by the Meridian LANStar PC system than by thin-cable Ethernet, under certain conditions. There are some complex reasons for this, but the conclusion you should draw is that the LANStar PC gives system throughput over twisted-pair telephone wiring that rivals the throughput of coaxial

cable systems LANStar PC systems become practical for networks of more than 32 nodes (servers and workstations). A small LANStar PC cabinet configuration (the size of a dorm-room refrigerator) services up to 112 nodes, and a large system (resembling a full-size refrigerator) can carry 1,344 nodes.



Meridian LANStar PC Northern Telecom Inc 2100 Lakeside Blvd., Greenway Bldg.

Richardson, TX 75081 (214) 437-8000 List Price: 32 nodes, \$26,335; 112 nodes, \$77,915; 256 nodes, \$184,915; 1,024 nodes. \$730,020: 1.344 nodes, \$987,850. Prices are

for selected systems only and include cabinets, power, line cards, PC cards, and wiring from PC to wall jack. Systems can be expanded at an average price per node of \$700 to \$750. In Short: Perhaps the best solution for cor

porate networks with more than 32 nodes, the Meridian LANStar PC offers fast access for interactive processing and is an excellent entry into the ISDN (Integrated Services Digital

CIRCLE 432 ON READER SERVICE CARD

SYSTEM COMPONENTS The LAN-Star PC has three major elements: an equipment cabinet, an interface card for each PC, and telephone wire. The network interface card is full size, designed for the 8-bit PC bus, and otherwise unremarkable. The standard six-turn-per-inch unshielded telephone wire is available from many vendors. If your building was wired for a telephone PBX within the last 6 years or so, it is likely that you already have the right wire in your walls. Every node needs two pairs of wire

Each LANStar PC network interface card includes a telephone jack, which makes it easier to get to the wire pairs running in the same cable. You route the telephone wire from the wall to the LANStar PC card and connect the phone to the jack in the card. From the wall tack, each cable run goes back to a central wiring closet for the voice telephone connections. In this closet, the pairs used by the telephone and the pairs used by the LANStar PC separate and go to their respective devices. This wiring scheme is not unique to LANStar PC: StarLAN is usually wired in the same

The LANStar PC equipment cabinet houses the electronic components that make up the packet transport equipment (PTE). The PTE is a true packet-switching system. Many typical PC-based LANs such as StarLAN. Ethernet, and Fox Research's 10-NET use packets, but their packets aren't switched. In both switched and nonswitched systems, a packet of data is constructed by enclosing all or part of the message in an envelope of bits. Every bit in the envelope has a purpose, such as describing the sender and addressee or checking the accuracy of the transmission. This packet isn't conceptually very different from the Token-Ring's "token." In nons witched packet systems such as Ethernet, the packet goes out into the shared network cable, and every station receives and examines it. The station to which the packet is addressed takes further action, but every active station reads every packet. This results in high overhead on the cable and requires the use of complex cable-sharing access schemes like CSMA and token passing.

In the LANStar PC system, instead of every station examining every packet and



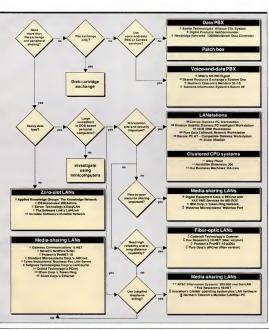
This chart is designed to help you select from among the many information-transfer and resource-shanng alternatives. As you can see on the chart, if all you really need to do is exchange files or share printers. then you should consider devices such as PBXs and patch boxes. If your organization has not already invested heavily in PCs or DOS programs, then a minicomputer might meet your needs more economically. But if you want many users to share data files simultaneously under DOS, a LAN may be the best alternative Once you've decided on a LAN, the need for station-to-station resource sharing and other factors will influence your network purchasing decision

Because manufacturers include many different features in their networks, some products will not fit neatly into one decision box in this guide. You'll also find that the lack of differentiation between LANs is becoming as large a problem in the LAN industry as the lack of standards was 2 years ago. But overlapping features and technical similarity between networks are good news for potential buyers. They will let you concentrate on more-traditional factors such as dealer support and price instead of on more-technical considerations.

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- cember 9, 1986 December 23, 1986
- January 13, 1987 January 27, 1987 February 10, 1987
 - February 24, 1987 March 31, 1987 April 14, 1987
 - May 26, 1987 June 9, 1987 June 23, 1987
 - July 1987 August 1987 September 29, 1987 October 27, 1987
 - January 12, 1988 January 26, 1988 February 16, 1988
 - March 29, 1988

Black marker indicates current issue



■ MERIDIAN LANSTAR PC

sharing a common bus, stations have dedicated connections to the PTE. The PTE switches the packets and notice such oneonly to the addressed station. This packetswitching system has a couple of drawbacks. First, it requires substantially more electronics in the switch, and the switch becomes a single point of faiture. Second, the configuration requires that every station have a declicated cable run to the PTE.

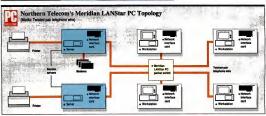
cabinet, so a LANStar PC installation takes more wiring than does Ethernet but not more than a Token-Ring or a PBX installation.

On the positive side, the telephone wire is much cheaper than coaxial cable, especially if it has already been installed in the right configuration. Additionally, the electronics in the switch reduce the load on the CPU of every station in the network, and

because the wiring is not shared, the heavy activity of a few stations doesn't slow down responses for all stations. The reliability of the system is enhanced through internal redundancy in the switch and particularly by the separate wire runs to each station. Damage to one wire run does not bring down the entire network the way it does in a station-to-station physical wiring scheme such as thin-cable Etheria.

What makes the LANSur PC a viable long-term alternative is its relationship to the Integrated Services [Digital Network (ISDN) transmission standard. ISDN is an international development program designed to digitar be telephone systems of the world. It is heavily backed by the rejoinal Bell companies, AT&T, and other large organizations. The goal of the ISDN initiative is provide several 64thyps data channels in every telephone wall jack channels in every telephone wall jack will lake a decade or more to reach real reads, but the LANSur PC provides an excellent entry to ISDN, for any comporator or

Northern Telecom's Meridian LANStar PC offers excellent throughput, carrying data for thousands of feet at a rate of 2.56 megabis per second over twisted-pair telephone wire. The system includes an equipment cabinet, an interface card for each PC, and telephone wire. It offers fast access for interother processing and is one of the most effective systems for metworks of more than 32 nodes.



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group network. Northern Telecom's designers understand ISDN, and the LAN-Star PC packet is designed to carry the ISDN 64- and I6-kilobit data channels.

LINKING WITH WINES Like Ethicular and Toker-Ring, the LANSHAR PCI wood connection scheme. The connection scheme the connection scheme the connection scheme the connection with the system. There has to be some software the connection of the connec

worthern Telecom established a technical and marketing arrangement with Baryan Systems of the Telecommunity of the year Systems of the Telecommunity of the telecommunity of the shell runs with DOS in every LANSar PC workstation. The VMPES software reducts the code needed to redirect DOS requests to and from the LANSar PC nework interface card. The requests are formed into packets and sent to the PTE, where are put onto the dedicated connection to the Baryans server.

A LANStar PC interface card placed in a Banyan server links the server to the PTE. At the same time, network interface cards from other manufacturers placed in the Banyan server can link it to strings of PCs connected over Ethernet, StarLAN, Token-Ring, or any of the other network systems the Banyan software supports. All of the stations connected to the server by these various cabling and access schemes share the same files and services under VINES. In this way, a LANStar PC system can integrate with many other types of PCbased LANs. You needn't abandon existing network cards and wiring to expand with a LANStar PC system.

MULTIPLE SERVERS The VINES naming scheme lets you have hundreds of servers on the same network, so a user isn't limited to the resources of one server at a time. This is particularly important in systems in which you want to put different applications on different servers to distribute.

the work load and reduce the risk of system failure. VIMES is not unique in this capability—most of the major network operating systems have it—but being able to use multiple servers on the same network becomes particularly important in large installations.

For example, it is relatively simple to set up a LANStar PC and VINES system so that someone working on a PC has Server 1's files assigned as the PC's G: drive and Server 2's files assigned as its H: drive.

 You needn't abandon existing network cards and wiring to expand with a LANStar PC system.

You can create this virtual drive arrangement using Ethernet or Token-Ring cards to make the connection, too, but there is an interesting difference.

Suppose someone with workstation drives configured as I just described on an Ethernet network issues the DOS command COPY G:*.* H:, and G: is a loaded hard disk drive. DOS on the workstation will work with VINES on the workstation and with VINES running on Servers I and 2 to move files, packet by packet, from Server I to the workstation and back out to Server 2. Other busy stations on the network are likely to experience slower network response times because of a heavy network load-even if they are using some other server. Since all messages travel on the same bus in typical PC-based LANs, a few busy stations slow down response times for everyone.

If the LANStar PC is used for the connection in this scenario, anyone using Server 1 or 2 will still experience delays because of heavy server activity, but people using other servers won't be bothered. Because dedicated lines go to each machine from the packet switch, the activities of a few don't affect the many.

There is a limitation on the ability of the switch to handle data, but its capacity is more than 40 megabits per second of data. That means 40Mbps of data in the switch. Considering the other limitations of the PC internal architecture and hard disk drives, the throughput of the packet switch is the least likely thing to limit the system.

least likely thing to Inst the system.

The LANSar For and WPE'S combination of the Combi

THE COST It is hard to compare the prices of the different corporate networking alternatives. If sufficient twisted-pair telephone wiring is already available, the wiring cost for the LANStar PC is eliminated; on the other hand, you probably can't ignore the costs of installing Token-Ring or Ethemet wiring. You could consider making the installation of certain types of Ethernet a do-it-vourself project: but with the LANStar PC, a vendor always installs the equipment. Finally, because of the initial price of the switch, the LANStar PC has a high cost-per-station rate for a few stations, but that figure drops as more stations are added to the network

Wiring costs aside, Northern Telecom says that the cost of the LANStar PC runs from below \$700 to just over \$800 per station. This includes the packet switch equipment cabinet and its internal cards, the PC network interface card, and wiring from the PC to the wall jack. You should add 3 to 5 percent for equipment redundancy in the packet switch. At do-it-vourself prices, you can pay from \$250 to \$600 each for Ethemet cards. If you use the more expensive version of Ethernet with cable taps and transceivers, the cost rises to \$800 per node, and you probably won't do much of the work yourself. At IBM's prices, the Token-Ring Network averages about \$800 per node. In equipment prices alone, the LANStar PC is competitive with vendor-installed Token-Ring and Ethernet alternatives. These equipment prices could

be important or minor, relative to the cost

FROM CREATION





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Benchmark Tests: Meridian LANStar PC

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The PC Lists LAN borehment tests are written in C and sar regression of Commercial solithers: We are the tests on a step-bed of the 6-MBst. All. For our test-bed to better simulation control the 6-MBst. All. For our test-bed to better simulation control tests on a medium sear enhanced 200 minus workstations, we have designed these loading tests so that a single station represents law to be interes the lead of a user performing an interactive test, the example, updating records) on a reflection tests (the example, updating records) on a reflection.

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time necessary for all of these operations. We ran the test on all of our ATs to load the network while intring yeat one of them. We then reduced the network or loading on the network. The Network Speed Under Load test pits is heavy load on the network restricted the pits of the network restricted the pits of the Network Speed Under Load test pits is heavy load on the network interface (cards, media, and so forth while placing an emmand load on the hard disk by having each.

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Network Speed Under Load Performance Times

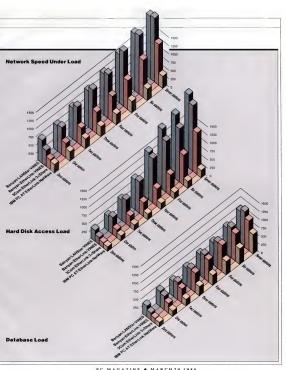
(Times given in seconds)			Zern	One	Two	Three	Four	Five	Sta	Savas
Servar	Interface card	Softwars	stations	station	stations	stations	staticas	stations	stations	stations
Banyan DTS DeskTop Server	Meridian LANStar PC	VINES	687	762	935	1.085	1.238	1,463	1,718	1.878
Banyan DTS DeskTop Server	EtherLink	VINES	479	812	1,067	1,225	1,320	1,650	1,775	1,925
3Com 3Server3	EtherLink	3 + Share	306	432	529	651	761	868	1,122	1,233
8-MHz IBM PC AT	EtherLink	Advanced NatWare 286	264	280	301	310	322	345	349	368

Hard Disk Access Load

Performance Time (Times given in seconds)	15		Zara	One	Twn	Thras	Four	Five	Sta	Savan
Sarvar	latarface card	Softwara	atations	station			atations			
Banyan DTS DeakTop Server	Meridian LANStar PC	VINES	332	431	614	907	1,414	1,812	1,924	2,220
Banyan DTS DeakTop Server	EtherLink	VINES	218	504	721	960	1,331	1.540	1,608	1,994
3Com 3Server3	EtharLink	3+Share	155	227	330	419	522	620	902	1,263
8-MHz IBM PC AT	Fitheri ink	Advanced NatWarm 286	136	150	162	174	182	187	210	227

Database Load

(Times given in seconds)			Zeco	One	Two	Three	Four	Flet	Six	Seven	
Sarvar	Interface card	Softwara	atetiona	station	stations	atations	stations	stations	stations	atetiona	
Banyan DTS DaskTop Server	Meridian LANStar PC	VINES	332	468	445	533	630	667	806	990	
Banyan DTS DeskTop Server	EtherLink	VINES	218	422	520	612	722	780	910	1,083	
3Com 3Server3	EtharLink	3+Share	155	298	425	585	669	799	824	901	
8-MHz IBM PC AT	EtharLink	Advanced NatWare/296	136	169	212	280	305	406	472	593	



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■ MERIDIAN LANSTAR PC

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OURTESTS Like every good LAN, the LANStar PC system is invisible in operation. Anyone using the system sees only the networking software. A good network administrator usually hides even this from the users by creating batch files.

Our evaluation system was installed in seven PCs and a Banyan server with the mere click and snap of RJ-11 telephone jacks. The most time-consuming part of the installation consisted of conving the VINES workstation files onto bootable DOS floppy disks. The seven 8-MHz IBM PC ATs were occupied in loading the network and server, with the net effect equal to the operation of two dozen PCs.

Our benchmark test results showed that the LANStar PC's performance is competitive with alternatives like Token-Ring and Ethernet. In some cases, it performed better than a "thin-net" Ethernet system using the same server, workstations, and networking software. The orderly delivery of packets to the server allowed it to operate at top efficiency.

Adding buffering to the Ethernet card in the server (in the form of a 3Com Ether-Link Plus card) would improve Ethernet's performance in our single-server test. But the point is that large networks typically have many servers, and adding more servers and stations to an Ethernet network would slow it down again. We expect the packet-switched system to remain efficient with many servers and stations.

If you're responsible for installing a network with hundreds of PCs, you should look at the Meridian LANStar PC, from Northern Telecom, as an alternative to media-sharing network solutions.

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.

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PRODUCTIVITY

■ PC LAB NOTES: LASER PRINTERS ■ CAROLINE HALLIDAY

CUSTOM-DESIGNING YOUR OWN FONTS

Though you can buy and edit commercial fonts, you can save money and learn more about how your LaserJet works if you take a more creative approach.

The font downloading and handling techniques discussed by Craig L. Stark in the previous issue will meet the needs of many readers. Generating fonts from "font outline" packages (such as those from Bistream or SoftCraff) gives you control over sizes and assures consistent, professionally designed typefaces multitude of additional vendors can supply fonts in still other typefaces, though their quality varies considerably.

Commercial downloadable fonts, however, whether ready-made or generated from font outline packages, may not be the solution you desire. For one thing, their expense is by no means negligible. Moreover, while it is undoubtedly faster to modify existing characters with a font editor than to design your own soft font, you'll learn more about the operation of your LaserJet II and its programming control language (PCL) if you roll your own. But be forewarned: preparing your own downloadable font from scratch is not for the fainthearted. The system is detailed in the HP Technical Reference manual and all of the information is there. I'll illustrate the process with a few letters you can see printed out on the sample landscape and portrait pages.

Designing your own custom fronts for downloading to the printer requires understanding the system used to specify the font. The soft front that is to be downloaded to the printer consists of three parts: the font descriptor for the font as a whole, plus a character descriptor and the actual bit data for each character in the font. HP recommends that any soft front that is general-owned that the printer of th

ed should be made to work across the whole LaserJet family. (Features such as the ability to use a different width line for the underscore stroke are not available on the series II printer, but other, more-so-

PRODUCTIVITY INDEX

PC LAB NOTES
Generating LaserJet fonts from scratch
for the do-it-yourselfer.
UTILITIES

CALC is a utility you can count on for math operations in many bases. ENVIRONMENTS

How C Library functions can get tangled in multiple threads. POWER PROGRAMMING C's output formatting function printf can even lend help to MASM. SPREADSHEET CLINIC

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Workable/impossible monitor combos; ready or not disk drive checkup. CONNECTIVITY CLINIC Conserving paper with the new PC LAN update; cost-cutting LAN tips. phisticated models do accommodate these features.)

FONT DESCRIPTOR The font descriptor consists of 64 bytes of data. The table "Font Descriptor Format" shows the format for the descriptor. All of the bytes labeled "reserved" should be set to zero. The font descriptor contains the width and the property of the set of the set of the concept character that will be in the font. Other features common within the font, such as the underline position, are also specified in the font descriptor.

A typical character cell is shown in the diagram "Character Descriptor Cell." Its height and width are expressed in units of index The character is last income and in the part of the character is income and in the certain market of the the character is in, is a certain number of dots below the baseline character cell. The underline character. The character cell. The underline character. The stellegist specification is the height of the stellegist specification is the height of the last two are not shown in the diagram, as they are ignored by the Laserlet.

Using the information gained from drawing out the foot character cell and taking care to ensure that the units are correct, you can generate the character descriptor. The DEBUG script file used to generate the downloaded portrait font used in the sample pages is shown in Figure 1. The "Bit-Pattern-to-Hexadecimal Conversion Chart" shows how different graphed shapes are translated into the DEBUG script, using the procedure described in my

PC LAB NOTES

previous (February 29, 1988) Lab Notes.

The diagram "Portrait Character Descriptor Cell" shows the character cell for the portrait font that is used in the sample pages. The character height and width must be less than or equal to the font descriptor character cell. The left offset dictates the number of blank dot positions that will be on the left-hand side of the character from the font character cell when it is printed. The top offset dimension is the distance from the baseline to the top of the character. The delta x dimension for the character is the distance that the horizontal position will be incremented to the right when the character has been printed. The minimum value for this distance must be greater than the sum of the left offset and the character width. Note that this distance, which is actually used only for proportionally spaced fonts, is measured in units of quarter dots and is rounded off to an integer dot. The format for the character descriptor data is shown in the table

"Character Descriptor Format." The graphics data that is sent to the printer for the character must be a whole

of dots in each row should be extended to the next multiple of 8 by using padding zeros. The distances in the first section of the

character descriptor do not include any padding zeros-only the image data itself. The format descriptor for a landscape font is different from its equivalent portrait font descriptor font only in the orientation byte. The character descriptor is very different, however. The diagram "Landscape Character Descriptor Cell" shows the dimensions for a landscape version of the sample character.

DOWNLOADING A SOFT FONT The various soft font commands fall into two ment. The management commands allow you to specify a soft font ID number, make a soft font temporary or permanent, or de-

lete it. To create a soft font, the font ID should be specified, then the font descriptor header, and then the font descriptor data. Each character in turn is then transmitted to the printer by sending the character code, the character descriptor, and the character data. The Escape sequence to assign a font ID of Lis

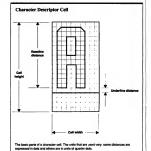
Esctc1D

The font descriptor header includes the length of the font descriptor data (64 bytes general categories: creation and managefor the LaserJet). The sequence to send this

e 100 00 40 00 01 00 00 00 96 00 64 00 C8 00 00 01 15 e 110 01 90 03 20 01 40 00 00 00 03 00 02 00 00 FB 03 0 120 03 20 01 90 00 00 00 00 00 00 00 00 00 00 00 e 130 53 41 4D 50 4C 45 00 00 00 00 00 00 00 00 00 00 r cx 49 q

number of bytes for each row. The number | Figure 1: A DEBUG script file to create a font descriptor.

Font Descriptor Format .. 10 - 11 12 14 - 15 18 - 15 20 - 21 25 26



font descriptor header is

Esc)s64W[64 bytes of data] The square brackets are not part of the Escape sequence. The script file shown for the font descriptor contains the 64 bytes of

data that describe the font. The Escape sequence that assigns the character code for the letter "A" to the following downloaded character is

Esc*c41E

The Escape sequence for the character to be downloaded will vary somewhat depending on the size of the character. The value in the Escape sequence represents the number of bytes that are in the character descriptor and the graphics image of the character.

For example, if the file size for the character descriptor and graphics image is 1136 (as in the sample portrait font "A"), the Escape sequence is

Esciel136Will36 bytes of character descriptor and dot image data)

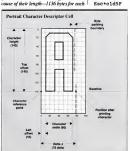
[The above should be a single line. Be-

 Designing your own font is a lengthy process, but the satisfaction of succeeding is great.

of 6 portrait sample letters and 988 each for their landscape counterparts-we cannot print these files here. To check your work, download these files from the PC-IRS .- Ed.1

FAULT-FINDING A SOFT FONT Fault-finding a downloaded font is not easy; unless the descriptor is correct, it is rejected by the printer. First, just send a font descriptor and make the font a permanent soft font. The font with an ID of 1 is made permanent by using the soft font management command sequence

Esc*c1d5F

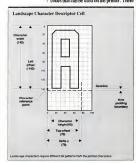


Then use the front panel of the printer to print the resident fonts. If the font descriptor has the correct syntax, there will be an entry on the sample fonts under the listing of "PERMANENT SOFT FONTS" Make corrections to the descriptor until the H-P font sample page shows the correct pitch and point size. Remember both that a smaller value for the pitch means that the characters are spaced farther apart and that there are 72 points in an inch.

Once the font itself can be downloaded, try downloading the character descriptor and data for the letter "A". This too will appear on a printout of the font sample page. Once the first couple of characters are correct, the rest can be sent and a text file that prints all of the alphabet can be used to DEBUG the full set.

Designing your own font is a fairly lengthy process, but the satisfaction of succeeding is great. It is possible to design a font with only a couple of characters in it, say, just enough letters to produce the name of your newsletter.

The Users Manual for the LaserJet series II contains a list of all of the Escape. codes that can be used on the printer. There



■ PC LAB NOTES

are additional variations on the commands, such as deleting all of the temporary fonts or selected temporary fonts, that were not detailed in these articles but are intuitive when the basic principles are understood.

SAMPLE PAGES Two sample pages have been included to illustrate some of the printer features described here and in the February 29, 1988, issue. One is a portrait page shown in Figure 2 and the other is a landscape page shown in Figure 3. The codes used to create each page are listed in Figures 4 and 5. Remember that when you are entering them for yourself, the letters Esc must be replaced by the actual ASCII Escape code (decimal 27), and that all lines that begin with a three-characterwidth space are actually direct continuations of the previous line of code. [We had to break long lines in order to print them.-Ed.1

The portrait page uses relative and absolute cursor positioning in both rows and columns, and dots to move the cursor. The

Bit-Pattern-to-Hexadecimal Conversion Chart

At 300 dpi, an image that is 4 bits wide is very small, measuring 0.013 inches.

Decimal	Pattern	Hexadecimal
0	ПП	0
1		1
2		2
3		3
4		4
5		5
6		
7		7
6		
9		9
10		A
11		В
12		С
13		0
14		E
15	_	F

Character Descriptor Format

Byte number	Description	Value set for LaserJet				
0	Format	Unsigned byte	4			
1	Continuation	Boolean				
2	Descriptor size	Unsigned byte	14			
3	Class	Unsigned byte	1			
4	Orientation	Unsigned byte				
5	Reserved					
6-7	Left offset	Signed Integer				
8-9	Top offset	Signed integer				
10 - 11	Character width	Unsigned integer				
12 - 13	Character height	Unsigned integer				
14 - 15	Delta X	Signed integer				
16 - 64	Character data					

The orientation, left offset, and top offset change when orientation of the font is changed.

PC MAGABINE LABES PRINTES LAS MOTES, PART 2, SAMPLE PORTRAIT PAGE

SAMPLE GRAPHICS IMAGE AT DIFFERENT RESOLUTIONS.



A Graphics Image at 75 dail with a pattern behind in



(Lafe) graphics image of 150 dpt with a 50% gray moste behind (1. (Bight) Graphics Image at 500 dpl with 90% gray.

SAMPLE OF CURSOR POSITIONING COMMANDS FUSH AND POP.

The first cursor position is pushed:popped, the old cursor position is restored. then the cursor is moved. When the cursor is

SAMPLE MACRO CALLED AND EXECUTED.

Storing the graphice image se a mecro allows it to be printed repeatedly without resending the data.

The ourser position to not preserved after a macra to called or assessed





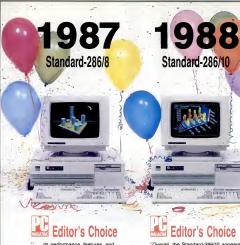






ABCDEF

Figure 2: PORTPAGE sample page. The soft font information is sent before the print commands.



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PC MAGAZINE LASER PRINTER LAB NOTES, PART 2, SAMPLE LANDSCAPE PAGE

SAMPLE GRAPHICS IMAGE.

Correct landscape graphics image with rotated date.

Some image if downloaded without rotating the data



SAMPLE MACRO CALLED AND EXECUTED.

Storing the graphics image as a macro allows it to be printed repeatedly without resending the data. Setting the resolution outside the macro allows the image to be printed at different resolution









SAMPLE PORTRAIT SOFT FONT

A soft font can be downloaded to the printer and then used:



A table outline can be overlaid on every subsequent page by the use of the overlay command. The ahaded area behind the aoft font is an overlay.

Figure 3: LANDPAGE sample page. Forms can be automatically generated using the overlay command.

Esc*cinesc; s64w[64 bytas of foat descriptor data] default HP fonts are used for the most part Esc-c65EEsc(s11364)[1136 bytam of character descriptor data for E] Esc-c66EEsc(s11364)[1136 bytam of character descriptor data for E] Esc-c65EEsc(s11364)[1136 bytam of character descriptor data for E] Tac-c-6FEEsc(mil36w|1136 bytes of character descriptor data for D: Esc-c-6FEEsc(mil36w|1136 bytes of character descriptor data for D: Esc-c-6FEEsc(mil36w|1136 bytes of character descriptor data for E: create the titles.

The first demonstration on the page Eac+cld5# Eccamigicascialanc Magazine Lazer Printer Las Moter, Part 2, SAMPLE PORTRAIT

Eac+p200x0YEsc+c2030a5b0p5a120b0P Eac+p200x120YEsc+c2030a5b0P Esc*p2230x0YEso*o5a125b0P

ESCANSTRUCESCAMPLE GRAPEICS IMAGE ET DIFFERENT EESOLUTIONS. ENCAME

Ecc(SUEac(aSp16.66hE.5vSaSbST Eac6a25c1SEA Graphics image at 75 dpi Eac6a25Cwith a pattern behind it.

Esc*p5@x41@YEsc*0275a3@@b1q3p

Esc*p75x455TEac*t75REsc*r1E[Data for portrait graphics imags]

Esc+p1135x476YEsc+c137a156b56q2P

Figure 4: The Escape codes used to create the partrait page sample. Relevant binary data belongs wherever the phrase [Data] is shown. Do not hit a carriage return before indented lines.

for the text on the page. The bold feature and the underline command are used to

downloads the graphics image from my previous article, at three different graphics resolutions. It also prints a different builtin pattern and gray scale behind each image. The push and pop commands are then demonstrated, though in a way that admittedly looks odd.

The sentence is printed as far as the colon and then the cursor position is pushed onto the cursor position stack. After a CR-LF the sentence is completed and the next one started. When the space after the word "is" has been printed, the cursor position that was pushed onto the stack is popped off and the rest of the sentence is printed in bold type, at the point where the stack po-

(continues)

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The drawing shown below was produced on the



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How to pull off a fantastic HP plot for only \$4900.



■ PC LAB NOTES

sition had been saved.

The next test demonstrates the use of macros. The same graphics image is transmitted to the printer, but this time it is stored as a macro, so it can be used many times without having to retransmit the data. The three images on the left of the page are printed by calling or executing the macro. Since the cursor position is not preserved when the macro is called or executed, the images are not in a straight line as the command sequence might lead you to expect. The three right-hand images are produced in the same way, but in this case the cursor position is pushed directly before each macro and popped directly after

the macro is completed. The last test printed on the page shows a few letters from a downloaded font. The font is selected by its ID number in the sample page, but its full characteristics could have been specified with similar results, as a word processor would.

The file to print the page is composed of many small files. The font descriptor is

The LaserJet printer is a magnificent machine that has recently become cheap enough in price for most people to consider.

sent first, followed by the character descriptor and character data for each letter in the font. The font is then made permanent with an ID of 1. The information for the page itself is the remainder. As with the font descriptor information, this contains binary information and should not be loaded into a text editor. The file was generated by taking each of the individual files that had been tested and combining them into one file, called PORTPAGE, using the DOS COPY command with the plus sign key. The text information for PORTPAGE is shown in Figure 4.

The landscape page is produced in a generally similar fashion to that for the portrait page, but the soft font information

Esc*pli#9K455TEsc*ti59KEsc*rlh[Date for portrait graphics image]

Escia7SciFR(Left) Graphics image at 159 dpi with Escia7Sca 58t gray scale behind it. (Right) Escia7SCOraphics image at 385 dpi with 15t gray. Esc(SURSc)sSpiShl27SsSb37

Esc *p2156x500TEsc *o65a75b19c3r

Esc*p2365x446TEsc*t365EEsc*ria(Date for portrait graphics image)

RECESTSTRUCTURES OF CURSOR POSITIONING COMMANDS PURE AND POP. Recede

oss]ErSCThe first cursor position is pushed:EsoSSES oss]inSCthen the cursor is moved. When the cursor isEsoSfiEEso(s]Epopped, old cursor position is restored.Eso(sES

SPORGZÝTÝCE-ORÁŠÍDSAMPLE MACRO CALLED AND EXECUTED. EFORÁŠÍ

Escialificationing the graphics image as a macro allows it to be printed repeatedlyEscialOwithout resembling the data.

ScotflySERsc+ti5Gemsc+riA[Date for portrait graphics image]

EccialSr2CEsc(SUEsc(sSpi6.66h8.5vSsSbSTThe cursor position is not preserved sfter a more is called or executed.

Hac+p1680y158xHackfly2xHac+p+208xHackfly2xHac+p+308xHackfly2x

Escas26r86Cuse push before a macro and pop after Escas26Cto preservs the cursor position.Esc(SUEsc(s0piShi)v6s6b3T

Esc+pi8SGy10SGEEscsfig2EEscsfig2EEscsfisEsc+p+3SGEEscsfSGEEscsfig3EEscsfig Esc+p+3SGEEscafig2E

Escha45rfCEschdfDSAMPLE PORTRAIT SOFT POSTESO

Eschaffrich soft font can be downloaded to the printer and then used:

Beckelly Street | EARCHER

(Figure 4 ends)

Eac-clDEsc)s64W[64 bytes of font descriptor data] Eac-cldEsco(s650W[695 bytes of charactar descriptor data for A] Eac-cldEsco(s950W[695 bytes of charactar descriptor data for B] Eac-cldEsco(s950W[695 bytes of charactar descriptor data for C] Eac-cldEsco(s950W[695 bytes of charactar descriptor data for C]

ESC-COSELEC(9988W|986 bytes of character descriptor data for E| ESC-COSELEC(9988W|986 bytes of character descriptor data for E| tes of character descriptor data for F ESC*C/SEESC(SSSSM(SSS Dytes of character descriptor data for F)
Esc*cidifescaliomscaliti@cesc(simpc MAGAEINE LASER PRINTER LAB NOTES, PART 3,

SAMPLE LANDSCAPE PAGEESC(86E Esc*p389x8YEsc*c2888a5b4p3s128b89 Esc*p544x128YEsc*c2884s51 Esc*p2568x8YEsc*c5s125b82

PROSESTROPPORTURE OF THE PROSESSED FOR THE PROSE

Esc(SUEsc(SSp18.68h8.5v8sSbST Esc6s5c7RCorrect landscape or rect landscape graphics image with rotated data.

Esc+p646x455YEsc+t75REsc+r1A[Data for landscape graphics image]Esc+rB Esc4s145c7REams image if downloaded without rotating the dats.

Esc*p2488x685xEsc*t75REsc*r1A|Data for portrait graphics image|Esc*rE Esc(SUEsc(sSp1Sb12v6sSb3r

Escasi7rSCEscad@DSAMPLE NACRO CALLED AND EXECUTED.Escad@

Figure 5: The landscape sample pages' Escape codes. Relevant binary data belongs wherever the phrase [Data] is shown. Do not hit a carriage return before indented lines.

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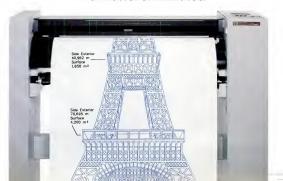
The drawing shown below was produced on the HP DraftMaster with AutoCAD software



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PC LAB NOTES

Escas19r1CEtoriog the graphics image os a macro allows it to be pricted repeatedly without resending the data.

Escafivexesc*rlaiDete for landscape graphics image:Esc*rBEscafix18x

Escis28r15CEsc(SUEsc(s8p16.66hs.5v8s8h8Tvetting the resolution outside the macro allows the image to be prioted at different resolutions from the same macro. Esc(SUEsc(spish12v8sb2)7

Esc*p1158y688XEsc*t75REsc6f8s1y2x1Esc*p+686XEsc*t188REsc6f8s1y3E Zac&fistac*p+600xtac*t150xtac&f0aly2x1stac*p+600xtac*t300xtac&fly3t

Escaf2y8xEsc*p1775y768xEsc*c1288s175h38g2FEscaf1x

Escaseirica table outline can be overlaid on every subsequent page by the use of

the overlay command. The shaded aras behind the soft foot is an overlay.

ESCASSFECESCAGEDSAMPLE PORTRAIT SOFT FONTESCAGE Escéal2rica soft font can be downloaded to the printer and then used:

Eschaler25CEsc(1XA E C D E P

Esc (38

Eschalrischec(elbrc Hagarine Laber Printer Lab Notes, Part 2, Sample Labor PAGEFACIAGE

Esc*p500x0YEsc*c2060a5b0p5a120b0r Esc*p500x120YEsc*c2060a5b0x

Eac*p2560x8YEac*c5s125h07

EscasS2c5Rrage 2.

Escis25r3CThe automatic overley feature will coctique to print on every subsequent page ontil the macro is:

Disabled or deleted.
 Page length, size, or orizotetion is changed.
 Reset command is sect.

(Figure 5 ends)

that is downloaded creates a landscape font. The first test demonstrates the difference between sending a graphics image with and without rotating the data. Even though the orientation of the page has been

changed, the graphics image is not rotated automatically. The rotation must occur at the computer. The second sample test shows that the graphics image, without its resolution setting, can be stored in a macro. Then by setting the resolution and executing or calling

the macro, the image can be scaled. The sample soft font is selected and printed near the bottom of the page. The other macro stored on this page is the gray-scale rectangle printed behind the

soft font text. This is called by using the overlay command, then this shape is automatically overlaid on the subsequent page without any further commands. [For reasons of space, only one of the two landscape sample pages contained in Ms. Halliday's code is printed here. The other, showing the effect of the overlay continu-

ing onto the second page, will print out on your machine.-Ed.1 The file for printing LANDPAGE con-

tains the font descriptor information and then the character information before the data for the page itself. The file should be copied to the printer using the binary option. The text portion of LANDPAGE is shown in Figure 5.

The LaserJet printer is a magnificent machine that has recently become cheap enough in price for most people to consider. Its versatility and graphics outputs were simply not feasible a couple of years ago. So don't just use it for the output from a word processor; stretch its capabilities and produce more-exciting output for a satisfying experience.

Caroline Halliday is an electrical engineering consultant with High Tech Aid and specializes in technical documentation and teaching for the PC environment.

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A PROGRAMMER'S POP-UP CALCULATOR



Multiple base conversion, bit shifting, logical operators, and 32-bit number representation highlight an integer-arithmetic calculator that also handles two-place decimal numbers.

Imost invariably, the need to add a few numbers together arises minutes after I've loaded an editor word processor and its files. For various reasons—its size and the real and possible conflicts with other programs amount to the programs amount of the size of the size

CALC is my answer to the problem. It doesn't put a pretty picture of a calculator on your screen, but in addition to providing a two-place fixed-point decimal mode for financial computations, it gives programmers like me functions not found in most calculator programs.

CALC operates in hexadecimal, octal, binary, and decimal bases and will convert a number entered in one base into another at the touch of a key. Previous calculations can be carried over and operated on in a different base. CALC uses a full 32-bit representation for numbers, so memory addresses and other double-word calculations can be computed accurately. The standard logical functions, and, or, xor,

not, and negate, are also supported.
Although CALC does not provide for a
permanent record (this would have made in
just too big), its secren display looks a little
like an adding machine tape. After an entry
has been made or a result calculated, to
make room for the next entry. The window
make room for the next entry. The window
is large enough to display the last six entries, so you can keep your place when
adding long columns of numbers.

GETTING AND USING CALC Both the assembly language source code (CLA ASM) and a BASIC program that wrill recrate CALC. COM when you recrate CALC. COM when you will recreate CALC. COM when you will recreate calc company of the company

CALC is a memory-resident pop-up and so must be installed in memory before you use it. Just enter

CALL

at the DOS command line, or, better, make CALC a line in your AUTOEXEC BAT file. After installation, CALC remains quietly in memory using up only 3,500 bytes. When you need CALC, hit Alt-S. The CALC window will appear on

■ CALC operates in hexadecimal, octal, binary, and decimal and converts a number from one base to another

at the touch of a key.

your screen, NumLock will be turned on, and your last entry (if any) will be displayed. To return to the program you were using, just hit the Esc key. CALC will restore the screen and the keyboard locks to their previous states.

The first time that CALC pops up, it defaults to the integer decimal mode. This mode allows signed integer arithmetic with maximum values of up to ±2,147,483,647. The standard functions + , - , *, and / work as expected, so long as you remember that this is an integer mode, not floating point. (Dividing 4,096 by 10 vields 409, not 409.6.) You can hit F2 to change the calculator to fixed decimal mode. In this mode, a decimal number can be entered with up to two decimal places, which is ideal for working with dollar values. [Note, however, that numbers that would fall into a third decimal place are truncated rather than rounded.—Ed.]

In integer mode CALC supports the mod function, i.e., it can provide the remainder of an integer division. When 25 is divided by 8, for example, the remainder is 1, so 25 mod 8 equals 1. To use the mod function, two keys are available. As in the Clanguage, the percent sign, "%", is the mod operator. To provide an unshifted alternative, the backslash "\" also performs the same function.

Repeatedly pressing F1 cycles the calculator through its four integer bases: decimal, hexadecimal, binary, and octal. As the base changes, the number on the bottom line of the display changes to the new base. F1 provides a quick way to convert a number from one base to another. Pressing

UTILITIES

the Enter key scrolls the current number up one line and repeats it on the entry line. Hitting F1 at this point changes the base of the number on the entry line (without scrolling it) to the base signified by the letter (d, h, b, or o) in the far left margin.

Function keys 3 through 6 provide the standard logical operations, and, or, xor, and not. For the first three, you use these functions as you would a math function. Enter the first number, press the desired function key, enter in the second number, press Enter, and the result is displayed. To use the not operator, simply enter the number and press F6. If no number is currently on the entry line, the last result will be in-

Assembly language programmers will particularly appreciate CALC's built-in shift function. If you press F7, CALC will shift the number currently on the entry line one bit to the left. F8 shifts the number one bit to the right. By repeated use of F7 or F8, numbers can be shifted any number of bits. CALC performs shifts arithmetically. Shifting arithmetically means that a number shifted to the right will retain the value of the most significant bit. Numbers shifted to the left will have a zero inserted in the least significant bit. Thus, if a number is shifted to the right, the shift has the same result as dividing it by 2. If the number is shifted to the left, the shift has the same result as multiplying the number by 2.

F9 is the negate key for CALC. The number currently being entered is subtracted from zero and displayed. If there is no number currently being entered, the sign of the last result is changed. For decimal and fixed modes, F9 provides the same function as the Change Sign key on a regular calculator.

Pressing F10 clears the entry/result line, and Shift-F10 provides a clear display function. This allows you to completely reset CALC by clearing the display as well as any pending operations.

HOW CALC WORKS The CALC .COM program can be divided into four major sections. First is the terminate-andstay-resident (TSR) code. The second part is the keyboard input of the operators and numbers. The third is the actual 32-bit math involved in implementing the functions, and the last part comprises the code

that displays the numbers.

highlights

The TSR code is responsible for monitoring the keyboard while dormant, for saving and restoring the screen, and for returning to the original program when the Esc key is pressed. As a number of columns have been written on the ins and outs of designing TSRs. I'll discuss only the

When CALC is installed, the initialization code does nothing but redirect the keyboard interrupt vector and reserve memory

 Assembly language programmers will appreciate CALC's builtin shift function. By repeated use of F7 or F8, numbers can be shifted any number of bits.

for the program. Because the configurations of today's PCs are quite dynamic, little can be determined until a TSR is actually invoked with its hotkey. After installation, CALC examines each keypress, and when it finds the proper hotkey combination (in this case Alt-S) CALC begins the process of popping up.

The latest generation of video cards can produce wonderful displays, but they can be a real pain for the TSR programmer. Any TSR written today must attempt to be compatible with a wild array of diverse video configurations. CALC bends over backwards to provide full compatibility.

CALC starts by reading the BIOS data area to determine the number of rows and columns currently displayed. It then determines if an Enhanced Graphics Adapter (EGA) is currently active. It was once common practice simply to read the EGA BIOS for the "IBM" signature to determine if an EGA was present. If the signature was found, the EGA was in the system. This approach is not good for two

EGA card in the system does not mean that it is the currently active video display. Second, while the new Personal System/2 machines provide EGA compatibility, because the video BIOS is incorporated into the system BIOS, the "IBM" signature is not where expected.

The currently accepted way to check for an EGA-type display is to call interrupt 10h function 12h with BL set to 10h. If BL returns unchanged, there is not an active EGA present. If there is no EGA, CALC checks the CRT controller register at address 40:63. If bit 6 is set, then there is a monochrome adapter. Otherwise, CALC assumes a color graphics adapter is present. CALC modifies its windowing parameters to adjust to any nonstandard combination. All of these checks are done when CALC is called rather than during installation in order to accommodate a dual-screen PC configuration.

After the complete video configuration has been analyzed, the characters on the screen where the window will be drawn are saved. The current state of the keyboard is saved and NumLock is turned on. The CALC window is then drawn, CALC hides the cursor by moving it to one row below the last row of the active screen. This routine bypasses the bugs in the EGA BIOS. When the Esc key is pressed, the original state of the keyboard is restored. the screen is redrawn, the cursor is returned to its original location, and control is returned to the original program.

KEYSTROKE MONITORING Once initialized, CALC waits for a key to be pressed. Instead of simply calling interrupt 16h function 1 (the BIOS keyboard service). CALC first checks to see if a keystroke is in the buffer. If no keystroke is present, CALC calls DOS interrupt 28h function 0, the DOS idle loop. By calling the idle function, CALC allows another function to assume control of the system. If a keystroke is in the buffer, CALC then gets the keystroke and processes it.

After getting the keystroke, CALC checks to see if the key is the Esc key. If so, the program terminates. If not, CALC checks to see if the key is any of the valid nonnumeric keys. If so, CALC processes that function; if not, CALC checks to see if reasons. First, the mere presence of an the key is a valid numeric key. A valid numeric key is one that is less than the current base. (A 9 is not a valid key in octal mode, for example.) If the key is not a valid key, it is discarded. If the key is a valid numeric key, it is accepted and entered into the

"entry register. CALC keeps track of numbers using two 32-bit variables, one called the entry register and the other called the result register. As you might expect, the entry register stores numbers currently being entered while the result register stores the result of the previous operation. When a digit entered is within the range of the base, the entry register is multiplied by the base to make room for the new digit. The new digit is converted from ASCII to binary and added to the enter register, which is then displayed. For example, if the octal number 234 is in the entry register and the key 5 is pressed, the original number (in binary) would be multiplied by 8, giving 2340 (octal). The digit 5 is then added to 2340, to give 2345. Numbers are always stored as binary numbers regardless of the base be-

32-BIT MATH Performing 32-bit math with a 16-bit processor is not so formidable a task as you might think. Addition and subtraction are simple, thanks to the add with carry (ADC) and subtract with borrow (SBB) opcodes. Multiplication and division are slightly more difficult, but not exceedingly to the signal of the signal

ing used.

exceedingly so. To add or subtract numbers larger than the register size of the microprocessor involves keeping track of the carry bit. To add two numbers, CALC loads the low word of the result register into AX. The low word of the entry register is then added, using the ADD opcode. If the result is too large to fit into a 16-bit word, the carry bit is set. The high word of the result register is loaded into DX, and the high word of the entry register is added using the add with carry opcode. The add with carry opcode, ADC, adds the two numbers, then adds I to the result if the carry bit is set. This method allows any carry from the low word addition to be propagated to the high word. Subtraction is handled in the same manner, using the subtract, SUB, and subtract with borrow, SBB, opcodes. Overflows are detected by the microprocessor

and are indicated by turning on the over-

CUSTOMIZING CALC

A pplication programs and TSRs lay the along the calaim to many key combinations on the average Po. If your word processor happens to need the Alt-S that CALC uses as its default hotkey, the instructions here will show you how to change it. In addition, you can change the program's default colors.

Obviously, to make such changes you need a copy of CALC COM in your current directory. Make sure, too, that DE-BUG is either in your current directory or in a directory included in your PATH command. And remember the most important rule of debugging always work with a copy, never with the original. That way, if anything goes wrong, you can start over.

To change the default hotdey combination, first decide what you want the new activation key to be. You can choose a single key, like the letter A, plus any one or more of the shift keys (Shift, Crd, Al). The scan code for A, as shown in the table 'Keybourd Scan Codes for Alcrative Hotdes,' it is L. The shift "Shift," Ald Sk. Voltar, as leaden the "Shift," Ald Sk. Voltar, as leaden the collowing set of DEBUG instructions.

		CALC.COM	
		"Ctl-A"	;The new lette:
E	26B	12	;Scan code
E	275	4	;Shift mask
W			

If CALC's initial colors used aren't to your liking, you can change them, too. Three separate color combinations are used for the bottler, the text, and the headerment. The color codes are enhancement. The color codes are enhanced to the first digit is the bockground and the second digit is the foreground color. The choices CALC offers for a monochrome screen are limited to normal and reverse video. (The two other theoretical possibilities, underline and nondisplay, don't The choices for a color screen are shown.

Keyboard Scan Codes for Alternative Hotkeys

Key	Scan code in hex	Key	Scen code in hea
Esc	01	Z	2C
11	02	×	20
6/2	03	c	2E
#3	04	V	2F
\$4	05	В	30
%5	06	N	31
. 6	07	M	32
87	08	<,	33
*8	09	l >.	34
(9	0A	7/	35
10	08	Right Shift	36
	0C	PrtSc*	37
+=	OD	All	38
Backspace	0E	Spacebar	39
Tab	0F	CapsLock	зА
Q	10	F1	3B
w	11	F2	3C
E	12	F3	3D
R	13	F4	3E
T	14	F5	3F
Y	15	F6	40
U	16	F7	41
1	17	F8	42
0	18	F9	43
P	19	F10	44
4	1A	NumLook	45
19	18	ScrollLock	46
Enter	1C	7 Home	47
Ctrl	1D	8 Up Arrow	46
A	1E	9 PgUp	49
S	1F	-	4/4
D	20	4 Left Arrow	4B
F	21	5	4C
G	22	6 Right Arrow	4D
H	23	+	4E
J	24	1 End	4F
K	25	2 Down Arrow	50
L	26	3 PgDn	51
11	27	0 Ins	52
**	28	.Del	53
	29	SysReg	54

Loft Shift

28 F12

58 (continues)

57

(Customizing CALC" continued)

in the "Color Combinations" table shown on the right. Values above 7 should be used only for the foreground: they will cause the display to blink if used for the background. Choose your colors, then substitute them for the colors shown in the following examples.

	Го cha	nge the	monochrome colors:
DI	EBUG	CALC	.COM
Е	1C8	78	;Border color
	1C9		;Text color
Е	1CA	97	;Header color
W			
0			

SHIFT-MASK Value Table

	Shift key (@ = Pressed)					
SHIFT-MASK Value	Alt	Ctrl	Left Shift	Right		
0						
1				•		
2			•			
3			•	•		
4		•				
5						
6		•	•			
7		•	•	•		
8	•					
9	•			•		
A	•		•			
8	•		•	•		
C	•	•				
D	•	•		•		
ε	•	•	•			
F	•	•	•	•		

flow bit in the flags register. Multiplication is not that hard to handle. As with any big job, the way to handle a 32-bit multiply is to divide the iob into small parts. In a microprocessor, 16- by 16-bit multiplication produces a 32-bit result. Using this logic, 32- by 32-bit multiplication produces a 64-bit result. To make room for a 64-bit result, the multiply must be divided up into four parts. The four parts are created by dividing the two 32-bit word into four 16-bit words. Using the example shown in the diagram "Multiplying

Color Combinations

Value	Color
0	Black
1	Blue
2	Green
3	Cyan
4	Red
5	Magenta.
6	Brown
7	White
8	Gray
9	Light Blue
A	Light Cyan
В	Light Red
C	Light Magenta
D	Yellow
E	Bright White

Select the colors for display and use the hex value to construct the attribute. Bright hite on Red, for example, would have he value E4.

To change the color display: DUDUIG CAT C CO

E 1CD	ØF	;Border color
E 1CE	1F	;Text color
E 1CF	1E	; Header color
W		

-Robert L. Hummel

Robert L. Hummel is senior technical editor of PC Magazine.

Two 32-bit Numbers," the hex number 12345678 is multiplied by 9ABCDEF0. The number 12345768 is divided into a high and low word producing 1234 in the high word and 5678 in the low word. In the same manner the second number is divided into 9ABC and DEFO. The multiplication is then done as four 16-bit-size multiplications. The two high words are multiplied. then the low and the high, the high and the low, and finally the two low words. The words are then added up. The trick here is to retain the place of each of the words.

The products of the word multiplications are then added to produce the final result The easiest way to understand this process is to write it out as in the diagram.

If this looks like math from grade school, it should. The only trick to the multiplication is to keep track of how the partial products are added. The 8088 helps us here by placing the low word of the

The 8088 only allows the division of

a 32-bit number by a

16-bit divisor.

product in AX and the high word in DX. By using the other registers in the processor to hold each one of the columns, you can collect a running sum of each column as you perform the multiplication. In CALC, the highest column and the second column are summed in CX, the third column is summed in BX, and the lowest column is in AX. Having AX hold the lowest column is possible since CALC performs the low-word-by-low-word multiplication last. As the partial products are added to the registers, the carries of the additions must be propagated to the next register.

duces a 64-bit result. CALC has room internally for only 32 bits. To solve this, CALC accepts only results that will fit into 32 bits. To detect overflow, a result larger than 32 bits, CALC checks to see that the upper 32 bits of the product are zero. If either of the upper two words of the product are not zero, CALC throws out the result and indicates an error.

Although 32-bit multiplication pro-

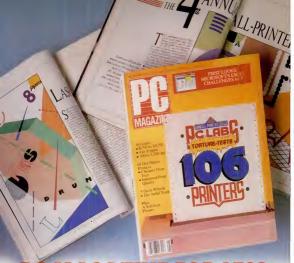
The division of two 32-bit numbers is slightly more complex. Although the 8088 provides a divide opcode, it only allows the division of a 32-bit number by a 16-bit divisor. To get around this limitation, CALC checks to see if the number in the entry register is larger than 16 bits. If so, both the registers are shifted to the right until the number in the entry register is small enough to fit into the low word. Since both the numbers are being reduced by consec-

PRODUCTIVITY

rate for the		ereces) computer - 1	887 by Douglas Beileg		200	e1	reelaced.
ice_deta		st at 46h	19100 deta eres		bob	dx cn	,
toe_kbd_etet	db 7		;keyboard states byte				
es_ert_eel	er9,	4+h	inumber of columns on the ecrose	match cuts		••	
		#391		quick_out: ; stort of main1:	340	careld_int_%	
ddc_6845	4 4	40)	6841 Index Register address	painl:	cell.	code. Clean up interrup hb recet	t state and check wideo mode. The bot hay combinating hem b
es ert rew	ds 7		immed of town		push	1	The bot key combination has be present, spring into acting presenting the keyboard
-					*****	e descode	
ide		nt pere public 'code e cescode	•		BOT	ax, hime_date	I date segment register.
	ere 1	743			****		
try:	(m) (mitielise MGC 1.0 (e) 1988 elf	jump to initiallastion code Communications Co. ".11.18		804	es, serbise ort col one vid col, as el, es bise ort row	seave the number of columns
,		C eeges.ee ",254," D	f Communications Co.",13,18 cogles Noting",13,18 18,"5",185		807	el, estados ert rev	seave the number of rows
apter			18 - CCA, 1 - MOA, 2 - ECA ; number of rolumns on screen		807	ous vid rows, al	seeve the state of the heyboar
wid cal		dv 1			nev	old Abd status, ol	pert num-lock on
		e~ 1	jvideo segment address				Check for BSA by testing wide feeting 12h. If hi returns unchanged, them ECA is not
page oder ettr		db 7	reur-ent Video page relator border ettribute		Let	51,105 105	function 12h. If hi returns
et ettr					-	31.163	present.
ader_ettr ndov_row		do 7 do 3	prindow header sttribute prow of left corner of window		304 804	main110 edepter,0	;not bik, sesume cik
			real and left corner of window			mum vid rows, 24	180 ega must be 25 rows.
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GATAGE DOS		dw 1	proreor pusition	********	Lee	adapter	gest ee to same segment se end
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					Let		,
cry_pree		4	pentry reg nonempty flag		cosp 11s	el,3 mein2	is carrent wideo mode 6 - 3 ?
try ree his		e- e	rumet eignlficant 14 hite		-		
ney ree low		6v 8	pleast eig. 16 hits for entry num	dom.	50	maintll	yes, then herech. slee, sait.
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era wheere	1	sterrupt \$ 10 pecers	ted by the PC beyboard.				
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	1ce	dercy ont			661 666		screen is < FF, don't pop a
	eti	**	100, start initialisation, first		BOY	column ndj.se	plave video page.
	push push		registers.			v page,bh	Het cursor position, save it,
		ex dx			Les	18h	then position the curser to come row below the screen so
	pash	•1			207	old cursor pos,da	; that it will be hidden.
	peach peach peach peach peach is	4			***	40.4	
	push	**			mov lot	4h,2	
	pesh	at sen	cost area code from benhased		lnt	ective.1	; indicate cale is sctlys.
	свер	41,31	igst aceo code from keyboard ichech for 'e' key		tell		
	cmp jee ser int	eut1	yee, then mait-		20E	di,orreen_beffer	;Howe the acress where the ; window will be. Then, pop u
	int		,		cell	ecres o ope	
		e1.0fb	scheck eit her				: Display the mesterts of the : of the entry register if : semething le in it, slau
					200	solry pres, 9	1 as one aurah tedratet IL
	cmp		relt bey pressed, pop up.				
	cmp	to the	strit. first restore registers.			21	; display the result register
t).	je jeop pop	main1		main32+	inc inc	al display_reg	display the result register

■ UTILITIES

) The window	is now	displayed no the ecreen.	wait for a keypress. ;Out the position of my 'cersor'.	key_end: bey_proc	ret		tenq
	BOY	ds, sy cereor pos	; then write it to the acreen.	i procese be-			is the bene flee, then display res
	cell	ab, beader ettr			e chan	ges - Chasge the value	is the bene fleg, then display reg
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M10811	Let	283	;indicate dec, bex, ect, his, fix ;gat a hayprese by first executing ; e dos idle long, be let other ; progress have a chance, then	1	50	been fixed	,,,
	mov Let	sh, 1 16h	programs have a chance, then		cirp	hase fixed fixed_flag,1 hase_fixed	rif in fixed mode, only change
	30	meicel	schooling for a key before sectually getting the key. If no key, idle equic.		34	ax,been fleq	to decimal to the base flog, add 6 and
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	je cep		yes, clean up and exit	1	add.	+1,16	; mero result for bex.
	tee	e1,70		base_cl:	mov See	al,18 heen_flog.ax ebort base_sed heen_flog.10 fixed_flog.0	
	tike.B.B.	book space	ryes, process backspace	been_fixed:	(mp	hees_fleg,10	; Make eare base " 10 then ; if strendy in fixed, make ; integer by dividing by 100.
mint:	200	abort major	tie it edift fie ?	1	cup	hase fixed)	interesty in fixed, name
	3.		yee, jump to clear routine.		34	base fixed! fixed fleg. 0	
	Chip	ah, 50	rie it fl ? ryee, change hame		BOY	decimal flag. #	room for the frection by seltiplying by 100.
	é	40.40	110 15 12 7				
	3*	ab. 64	yee, change been		cell	fined edjust dijoffeet entry_req.	hlah
	emp 51		is it between fs and fld ? If es, cell meany operator	1	cell	fined edjust short bees and	
	19 19	ah, se maleé	routine	here finedi:	jep lec	short bees and fixed flee	cast fixed fleq
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		key_proc			mov	fined adjust di.offeet entry_reg.	hish
ening.	cell	base chang short mains	off or fl, change been	base and:	cell mov	fised_edysat	
. Dansen he	jap has b		geto end d exit.	D000_0001		entry_pres, 0 hese_end1	idealey result register unless
end_111	807	di.ocreen_boffer	speint DI to holding buffer	1	2* 100	here endl	; entry register.
	cell	61.1		base end):	call	display req	; entry register. ; change register flag for the ; displey rectime.
		dr,eld cureer poe	:restors widen memory ecotomics ;nestors the cursor to the		ret		,, ,
	807	bh, e gage sh, 2	position it was before cold	bese_cheng	endp		
	iet	18h		1 mulitply as	4141	de registers by 100	
	jep	active,#	preset status fleg	1 ength op .	1. 41	vide. ch = 0, multiply	γ,
maio	340	6014	14874	fixed edjust		Deec	(Moving free fixed to decimal
					posh		
process he	ra - Pri	cose e all keys het esc	, f1, f2, and f0 - f10		sall	bu, ise mul div ohrt	; and back equin meeds on cory; ; way to maltiply and divide by ; 100.
hay pere	prec	past			sall	be ise mul div ohre ha	
process he	prec	neer al.e	; see if extended key	famed editors	call pop ret	bu, ise mul div ohrt	y way to maitiply and divide by 199.
process he	prec cmp	neer el.e keye eb.el	;see if extended key	1	eall pop ret eadp	be, 100 mul_div_enct bu	
process he	prec cmp 504 Cmp	neer el.e keye eb.el	; see if extended key	i mulitply as	pop ret sedp	bulger and but ha	pend
process he	prec cmp 504 Cmp	neer ei,s kays eh,61 key,eed ah,50 hey eed	;see if extended key	mulitply as	call pop ret eadp	hs.100 mul div abrt hs de regiotore by ba vide. ch = 0, maltipl;	pend y.
proross he	prec cmp 504 Cmp	neer ei.# hay# eh.#1 hay end eh.#2 hay.ed abort hay mear	;see if extended key ;if extended, allow toly ; heye ii = file	i mulitply as	pop ret sedp	bs, ise sul_div_abrt hx for registers by ba vide. cb = 0, maltipl; mear	pend
process he	200 ST 20	meer el.e keye eh.el key eed ah.is bey eed short key oper el.joh	;see if extended key ;if extended, allow toly ; heye ii = file	mulitply as	ret pop ret eadp d diej i l, di proc mov push	ne, iso mul_div_ext ha de registere by ha de registere by ha ch = 0, moltiply mear el, eige cl, eige	y. 1 Moving from fixed to decimal
proross he	200 ST 20	meer el.# haye sh.#1 key med sh.#4 hey med sh.#4 hey med shert key oper el.## key &	;nee if extended key ;if extended, allow noly ; keye f3 - f18 ;is it lower than 8 ;yee, chest for other functions	mulitply as	pop ret eadp id divj	be, ise mul_div_eart ha for registers by ha for registers by ha wide. ch = s, maltiply mear called a sign, s	y. 190ving from fixed to decimal
proross he	200 ST 20	meer el.s hard hard hard hard hard hard hard hard	jose if extended bey jif extended, allow toly j heye 13 - 110 jis it lower than a jyee, check for other functions jost hase ines if he has	mulitply as	soy call pop ret eadp divi- l, di proc mov push mov	tw. ise mul_div_ahrt ha div_ahrt ha div_ahrt for registers by ha wide. ch = 8, maltipl; mear cl. sign ca sign. 6 hase flec. 19	y. proving from fixed to decimal
proross he	proc cap 300 31 cap 31 30 31 30 31 30 31 30 31 30 31 30 31 30 31 31 31 31 31 31 31 31 31 31 31 31 31	meef el, p lage eh, pl lage eh, pl lage, med ehert kay_oper el, 18h kay_mee_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees_fles kay_nees	;nee if extended key ;if extended, allow noly ; keys f3 = f18 ;ia it lower than 8 ;yes, check for other functions ;geh hase ;see if in hex ;if so goth obs mode checking	mulitply as	pop rati sadp d divj 1, di proc mov push mov	tw. 180 sul_div_akrt ha de registere by ba side. ch = 0, sultipl; near cl, sige cl, sige sign.0 hass_fleq.10	y. ;Noving from fixed to decimal ; and back again needs on easy y way to maitaply and divide by ; 149. The mach roctions also
proross he	200 ST 20	meet el,s el,s el,s el,s el,s el,s el,s el,s	jees if extended bay if extended, allow toly hays ID = fill is it lower than 8 jow, check for other functions jeet bear if so got bear mode checking present to seeld it model has if so got bear mode checking present to seeld it model has	mulitply as	pop rati pop ret endp d divj 1, di proc mov push mov cup jos cup	In the multi-mark har multi-mark har	y. proving from fixed to decimal
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j peorona kaj lavy pete kay p	proc cup jin cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup cup ji cup cup cup cup cup cup cup cup cup cup	made of the control o	jee if extended bay jif extended, allow only j heye f2 - f18 jie it lower than 8 jwe, then the other functions peel base jif so grow has med cheating processy to seed it jies grow has med cheating processy to seed it jwe, gots maken the heary jwe, gots maken growsening	mulitply as	pop rati pop ret endp d divj 1, di proc mov push mov cup jos cup	De, 100 maid/out mark ha for registers by ba evide. ch = 0, mallip); cl. sign cl. sign cl. sign dl. sign dl. sign dl. sign edj2 mord ptr [di].0 mdj3 mdj3 mdj3 mdj3 mdj3 mdj3 mdj3 mdj3	y. proving from fixed to docume. and heck spain succes as easy and heck spain succes as easy any to satisfyly and divide 37 and the rection is a second to
j peoresa kaj lavy pete kays:	proc cup jin cup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup ji sup sup sup sup sup sup sup sup sup sup	made of the control o	jmes if maxesded bay if stronged, allow only have \$1 - 118 in it leave than \$2 - 118 jmes, clean for other functions yes, clean for other functions yes, of in hear if a more how mode cheaking its major less than the heary yes, opts major greening ins, clean for white cheaking ins, then for white cheaking ins, then the whom is	; mulitply as ; entry; oh ; mal_div_ehrt	eall pop ret sadp ret	De, 100 mai div marc ha for registere by ba existe. cb = 0, seltip); meac existe. m	y. proving from fixed to docume. and heck spain succes as easy and heck spain succes as easy any to satisfyly and divide 37 and the rection is a second to
j peoresa kaj lavy pete kays:	proc cup jin cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup ji cup cup ji cup cup cup cup cup cup cup cup cup cup	man	uses if outsided bay jif strategies, liler only; hery \$3 - fill like the control of the processor, just, cheen for other functions per laws. If my per has mode otherking control to seal, the same just, got making processing, no, cheek for other characteris- zes [f maker low the like	; mulitply as ; entry; oh ; mal_div_ehrt	move call pop ret sedp ret sedp ret sedp ret sedp ret sedp ret sed	De, 100 mai div mart ha de registere by ba ejde. ch "0, maltipl; mear el, eige elign.0 ham fleq.10 med[1] word pir [di].0 meger el, eige elign.0 meger el,	pend proming from fixed to decimal and the head again mends on easy a way to making and distribution of the decimal and the de
j peoresa kaj lavy pete kays:	prec comp ins ins comp ins ins comp ins ins comp ins ins in ins ins in ins ins ins in ins in ins in ins in ins in ins in in in in in in in in in in in in in	mane to the second of the seco	pass if succeeded bay ill settended, allow only is it leaves the size jos, these the relations pass, these three these tentions pass if in base presents to seal; in sealest leave than the heart pass, the sealest control of the sealest pass, these three the heart pass, these three other characters pass if suggest the sealest pass, the sealest three the heart pass, the sealest three the heart pass, the sealest three the heart pass, the sealest three the heart pass of the sealest three three three pass of three three three three three pass of three three three three three pass of three three three three three three three pass of three thr	; mulitply as ; entry; oh ; mal_div_ehrt	wall pop ret eadp ret l, di prov push mov cup jos cup jes cup	De, 100 middly mark ha for registers by ba myide. cb = 0, meltipl: meat en sign co sign, 0 est; myide. cb = 0, meltipl: meat en sign co sign, 0 est; myide.	yeard The control of the decimal property of the control of the c
j peoresa kaj lavy pete kays:	prec comp 50s comp 51 50s 52 52 53s comp 51 som 52 comp 51 com	news lays lays lays lays lays lays lays lay	pass if satisfied by if extended, allow only is extended, allow only is at lower time of it is a lower time of it is specially at lower time if is specially at lower time if a special time time	; mulitply as ; entry; oh ; mal_div_ehrt	move call pop ret eadp ret each ret eac	THE LEG MARKE MARK	yeard The control of the decimal property of the control of the c
process hay process hay process hay process hay process hay be not be no	prec comp 50s comp 51 50s 52 52 53s comp 51 som 52 comp 51 com	man bare bare bare bare bare bare bare bare	pass if outsided by if entended, allow only if entended, allow only is it home them of you, check for other functions you, check for other functions you it is been if it has if	; mulitply as ; entry; oh ; mal_div_ehrt	move call poper of divide call poper of divide cap poper of cap poper	Da. 100 and	pand y jmoring from fixed to decimal and back equin enter on early yer to matisply and davide by early to matisply and davide by early to matisply and enter pend this matilian enterties pend this matilian enter on early pend davide and the sign of t
i process hey proc	prec cmp 50s cmp 51 cmp 52 52 52 52 62 62 62 62 62 63 63 64 64 64 64 64 64 64 64 64 64 64 64 64	man bare bare bare bare bare bare bare bare	pass if outsided by if entended, allow only if entended, allow only is it home them of you, check for other functions you, check for other functions you it is been if it has if	; mulitply as ; entry; oh ; mal_div_ehrt	move call poper ret in division of dindivision of division of division of division of division of divi	De, pps mail discounts by he has all discounts by he considers by co	pand The control of
process hay proc	proceeding the proceeding to t	the state of the s	part if extended bay if extended, allow only if any all of 18 in yet 30 - 1	; mulitply as ; entry; oh ; mal_div_ehrt	move call poper ret in division of dindivision of division of division of division of division of divi	De, 100 of regioners by he of regioners oner oner oner oner oner oner oner oner	pand The control of
i process hey proc	proceeding the proceeding to t	the state of the s	part if extended bay if extended, allow only if any all of 18 in yet 30 - 1	multiply as entry: 60 c mai_div_sort	move call poper ret in division of dindivision of division of division of division of division of divi	In 188 So registers by be so registers so reg	pand The control of
process hay proc	proceeding the proceeding to t	see a	pass if outsided by if entended, allow only if entended, allow only is it home them of you, check for other functions you, check for other functions you it is been if it has if	multiply as entry: 60 c mai_div_sort	move call poper ret in division of dindivision of division of division of division of division of divi	De, 100 cm and 100 cm	pand The control of
process hay process hay process hay be	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	see a	Jame 11 metanded baye 114 metanded hay been style 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 115 metanded hiller selly 115 metanded hiller hiller selly 115 metanded hiller hiller hiller selly 115 metanded hiller hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller 115	multiply as	sov call pop ret eadp ret eadp proc cap push sov cap jos cap jos cap jos cap jos cap sov sov sov sov sov sov sov sov sov sov	De, 100 on registers by he on registers by on registers on registe	Descript from fixed to decimal. The state of the state o
process hay proc	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	see a	Jame 11 metanded baye 114 metanded hay been style 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 115 metanded hiller selly 115 metanded hiller hiller selly 115 metanded hiller hiller hiller selly 115 metanded hiller hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller 115	multiply as entry: 60 c mai_div_sort	sov call pop ret eadp ret eadp proc cap proc cap jos call je sov cap jos call je sov sov sov sov sov sov sov sov	De, 100	Descript from fixed to decimal. The state of the state o
process hay process hay process hay be	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	see a	part if extended bay if extended, allow only if any all of 18 in yet 30 - 1	multiply as	sov call pop ret eadp ret eadp proc cap proc cap jos call je sov cap jos call je sov sov sov sov sov sov sov sov	In 188 and 181	promise from from to mental. Jenning from from to mental. Jenning from from to mental. Jenning from mental. Jenning from mental. Jenning from mental. Jenning from to
process hay process hay process hay be	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	week of the control o	Jame 11 metanded baye 114 metanded hay been style 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 114 metanded hiller selly 115 metanded hiller selly 115 metanded hiller hiller selly 115 metanded hiller hiller hiller selly 115 metanded hiller hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller hiller hiller 115 metanded hiller 115	multiply as	nov cull pop cull pop pop cull pop pop cull pop proc nov cup proc	De 180 miles av par miles av pa	Descript From Fixed to decision. The second from Fixed to decision. I was to be a fixed to decision. I was to be a fixed to the second to t
process had been been been been been been been bee	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	see a	some if weemend may be a server of the serve	multiply as	nov cullipop ret eadp proc swy cup proc cup ret swy swy cup ret swy swy cup ret swy swy swy swy swy swy swy sw	To 188 and 50 month of the control o	The second from flowed to measured. I would from flowed to measured. I would have a party market to measured. I would have a party market to the second flower for the second flower
process hay process hay process hay be	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	water to the control of the control	James 18 metanded baye 118 met	molityty ai molityty on i molityty on i molityty on i molity on i	now call pop call pop call pop call pop call pop call pop call proc mov cap proc cap call in call proc cap call in call pop ca	De 180 miles av par miles av pa	The second from flowed to measured. I would from flowed to measured. I would have a party market to measured. I would have a party market to the second flower for the second flower
i process had been been been been been been been bee	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	water and a second	Jose II Management by "I may of any of the control	molity on and give when and gi	nov cullipop	De 18 mars an	The second from flowed to measured. I would from flowed to measured. I would have a party market to measured. I would have a party market to the second flower for the second flower
i process had been been been been been been been bee	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	where the second	Jose II Management by "I may of any of the control	molityty ai molityty on i molityty on i molityty on i molity on i	nov cullipop	De 100 mars and 10	The state of the s
process had been been been been been been been bee	proc comp 37s comp 37s comp 37s comp 37s comp 31s 3mp cr comp 31s	Section 1.	some if weekend key compared to the compared t	molityly and strength of the s	nov cullipop	De les des de la companya del companya de la companya de la companya del companya de la companya de la companya de la companya del	and the second prime from the electrical second prime from the ele
i process had been been been been been been been bee	proc one proc proc proc proc proc proc proc proc	Service of the servic	Jones II weekende beg "I want 25 or 15 or	molity on and give when and gi	now cup jee now diw env diw env cup cup ie now cup jee	De les des des de la companya de la	part
i pecessa hap- hap-pece hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- hap- hap- hap- hap- hap- hap- ha	prece comp preceded to the com	The state of the s	Command to the comman	molityly and strength of the s	nov culli pop cu	The state of the s	production of the control of the con
i pecessa hap- hap-pece hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- hap- hap- hap- hap- hap- hap- ha	price one one of the second of	The state of the s	A STATE OF	molity's and self-self-self-self-self-self-self-self-	nov culli pop culli culli pop culli culli pop culli	The state of the s	and the second s
i pecessa hap- hap-pece hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- ichack for a- hap- hap- hap- hap- hap- hap- hap- ha	prece comp preceded to the com	Service of the servic	Command to the comman	molityly and strength of the s	nov culli pop cu	The state of the s	and the second price from the decision. The second price from the decision of the second price from the secon



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■ UTILITIES

mās mās	jze ect set	und word ptr (di)	ino, check for other keys	;Entry: al			
	Sec.		jact requeter				De crabitales
		word ptr 2(di) short un_end		wrate st cur	peec	er er	reeve registers on and da
nd:	cmp		pie it f7, left shift ?		peak		
në:	350 340 340 340 340 340 340	404 bl.s			204	da, or cursor per ab, test attr	;get cursor position juse proper display attribute
1041	549	obegt un31		l	cell		
	Cap	ab, 66 un5	jie it ff, right shift ?		110	es curser pesuda	INDIA DESCRIPTION
		h1.1		weels	200	da da	,
m31 r	celi	shift_reg			249	••	ingne with an
a5:	comp 51	e), 66	sie is fié ?	write at our			; dose.
	51	dr. de	;no, check for other beys			see all operators for t	
	BOY	di.offset entry res !	i seph	:Entry: ss	- 300-1	umeric heystroke	
	BOY	[di],dx 2[di],dx	iclear both requeters	ODER BESS	agoc		
	BOT			oper_proc	zenh	**	;save the key
	207	6(da), du ah, 93	(do we clear the accomp)		280 280	entry_pres,0	is there a number in the ent re
	Jee Sev				366	oper1 pending op, ex	ino, save operation and exit
0581	cell	ex,7 scroll window	;yes, do so by acrolling the ; window up ? lines.		305	ex,cx short operend	
,	1009	set#	/ Window up / lines.	oper1:	380 acho	pending op. sx	:get pending op and save new op
	100	short so end	14e 15 E9 7		est1		:process seth function
201	tep tee	un end	rno, check for other keys	operands	240	da Ca,d	
			; negate the result register.				
e_end:	celi	bi, satty gree display req	display requeter	000041	204	dx,cx	tess of extended code
				-,000	50		,
n_proc	endp				cell	el,	:print space to separate operate
process rush	***	lesert digits from the	besteerd jeto the entry register.	1			jest pending operation
onder her	2000	rest			cell cell	write at cur accoli window	dieplay operator
most_say		el. 39h	rese if a susber not a - f	opec5: opecen(1:	2011	parpir armon	uclear by
	jle	num;	yes, skip letter correction		307	estry res high.hx	clear entry requeter
und a	800	e1.9	convert letters to hem values		BOT	entry reg low, ha decimal fleq, bl	
	peth	**	reeve degat	1	mov	eetry pres,bl	
	BOT DOT	di.offset estry_reg.b	reh - 8, clear sign flag	operamit:	Pet	cu.ds	:done.
	свр			oberiot.	mab	gh. 61	scoovert hercode into offset
	jse	word ptr dl , s	other) If the entire requester to		002	ch,1 ch,1	
			; theck if the entry requeter is ; negitive, if an, negate it.		mor mor		
	cell lec	negate_reg			e66	bl,ch	spoint to correct isbel
umq#+	Pob Pob		jest the digit back	operlect:	204	el. (but	:display a space and 3 character: :get a character to display
	MOE.	dx.dx fixed fleq.#	itee if in fixed mode.	4		write at cor	.,
	78		See I IN Timed Node.		Lec	ha operloci	
	7.00	el,decimal_flag	and comes to take they assess made		200	short opens	
	7	sum11	off were in the fax point mode, sultiply all digits by 188	oper_proc	endp		
	34	nun28 hv. 16	, until the decimal fleg has	smeth proc -	ратова	ses all moth for the po	rogram
	mev mel	hu .	fraction digute shifting only		- mecil	welve of the operation	or * for result reg - entry reg
	cap	cl,1	the tentha digit.	seth proc	proc	1000	
	je mul	bx	; esterns.		BOY	he, ex dx, entry req high	loopy key privat
well:	CRP	e1,#			BOY	diseffeet result rec	1
	je 180 300 300	decumel flow			Ber.	di,effset result_reg	high
	804	ba.21dil			CHO		
and.	JAC .	bear Trods			2	netb#2 h1.#	
			jest upper 16 hits				
	свр	hose fleg.18		methet:	349 089	shert logic stert	rese if addition
	5* mal	here_fleq short man211				nethi	
um21# r	jap imei	short num211 hese fleg	make room for the new duque		(Mp	bl,	; see if subtraction
um2101	50 BOY						;eee if multiplication
	MOV MOT	(d1), ax ex.2(d1)	preturn high word part low is bits		50	nethed	; see if division
	mul	base flec	repeat shift to make room		50	nethod	3 man 16 G7A18700
unti	edd	mm, box	jedd in new digit		cap	h1, -e-	
	*44	(di), de	redd overflow to the high 18 bits		34	nethed bl. "\"	iees if mod operation
um42:	BOY	2pdij.ex screll wiedow hadore di			30	nethed	
TI 8 DOA HRI	CRO			Beth#7:	30 2007	1di), dx 21di), ex	:If operator not recognized, ; copy entry register to
	50	nen26	; register was orginally negitive			abort nethend	
un2fr				nethli	add ade	2)d1),ex (d1),dx	redd
	joe pov	entry pres, 0 num21	Check for a master in the entry		20		
	207	bx,pending_op	,	nethil:	340 sub sub	short netherd	resistant
	10e	h1, ***		CHILL	app	2;dij,ax idil.dx	
	jee cell	scrall window				metherr	spump to error if underflow
o#21 r	mov cell	61,1 dampley_req	display setry register:	market.	340 541	short netherd oul_dir	
	isc	entry pres	jectry reg contains a cumber	method:	ret		
um3: umber_key	ret	-		metherri	BOY	CX,4886b	spoint to error tag

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UTILITIES

	***			mirro(2)	xer	es,ex	sclear error flag
ogic_start:	cep	bh,61 losicl	page of and operation	miner:	205	ba .	unless off stack
	and and		perfore and		pep	CX, 4400h	prises our scale
	and Sep	2[di], as short legic and	region on and end	mul due	ret.		
giel:			print op and end page of or operation page, leek some more				
	500 07	loque2 (du).dx	ino, leck some nors		ter - e	hifte the requeter pop	nted to by di, 1 plere.
		21da1.ee		shift seg	proc		
ogic2:	jep cep	short logic end 30,43	priot op and and pose if nor operation		push	**	
ogres.	ine	logic_sod [dl],ds	;give up looking	shaf42:		dr. (di.)	rget the requeter pointed to by
	ner ner	[di],de 2[di],ex	iqu aqs		cep	ax, 2(di]	pere of left or right shift
logic_end:		21011, ax	;clear arror code			shifte	; if bled then left shift
				shift1:		du,1	
math_proc	endp				rer tep	short shifts	otheft 32 bate by shafting the trailing word first so that
multiply and	Dieid	- process multiply and	diside noth functions.	MARTER:		ex,1	
el div	proc	Dear		abifs5.	rel	da,1 [61],68	; shift the leading word.
		68.68	page of			21641.ex	
	SOA	word ptr (di),co	pare sign flag	shift_and:	Bob	de	
	190		ine, skip negation		pop		(done)
	cell	esquis_rug	rest 1 menation number	shift_res	endp		
ed2 s	lec	si, offset estry_req_b) word ptr [al], 0	de l'ant 1 malerine present	recete reco	eter e	subtracts a register f	rom terr.
	cab	word ptr [al],6	pase if negative	:entry: di p	custs t	n the requeter being n	rgated.
	jge	6	;ec, skip negation	negate reg	8000	hast	
	pesh	dl, ei	;neg entry register		MOL	da,du	jeleer de
	0011	Secreta reg		negate21	100	word ptr 2[di] dw,(di)	negate the register
	pop	a i m	cost 1 more negative number		BOY	(di),dx	
2 positive	number	, now is mul or die ?					
M21	peeb	be bl. ***	is an '' it must be divide	hegate_req	endp		
di.	jee	md4	; or mod operation.	jback_space	- Legos	e last digit entered :	n setry reg by dividing by the bax
d31	mer	ex, [d1] weed ptr [ea]	restrainly by entry high	back space	pror		
	-		inercial of entry man	sacs_space			hagh
	add nov	09,0X 88,216L1	cost result low		BOY	bs,bose flag ch.1	
	mul.	wood ptr 1si1	pastigly by entry high		200	fired_flag.0	
	add						
	807	be, se ex. [4)]	ratert high word of product root receit high		cap 5e	decimal flag, 3 back apl	
	mul.	word ptr 2(a))	imultiply by entry low		cell		
	add nov nov nul add edd edd edd cop jne cop jne cop	ex, dx ba, an	resetious to build final ecoduct		100	decine1_flag,2 back sp2	
	800			back_egi:	cell		
	mul	word ptr 2(al)	smaltiply by astry low	beck ep2:			
	-01	00.5	imultiply by sorry low complete upper 10 bits come if any overflow		38	back up5 bs.160	
	ine				500	derimal flag. 1	
	cmp	hese_flag,16	iff in hame 16 protect the sign i but by declaring an overflow		380 807	back spl hs, 16	
	170	br. s	; If it has been changed.	heck_ap3:			
4551	23		jost the operation back	beck apts	cell cen	mul day shet decime; fleg.d back sp5	
4551	pep	ex short mdend to rowtine.	jet the operation back	teck_ape:	Carp 28	back and	
Division par	t of ti	me rowtine.					
461	CRP	word ptr (e1),6		; display ne back_apt:	w entry sev	bi,i	rdisplay entry segister
	CRO		poor if entry rog = 0		cell	dusplay_reg	
4611	ja .	nderr	; if so, indicate error.	back and:	ret ende		2 done .
6631	in	fixed_flag, 0 ed?	Iff in fixed mode multiply the dividend by 188 to make room for the fraction.	back space			
	cell	eb, s	; for the freetane.	pdisplay reg	- 4719	es a register to the s te result rep. bl - 1,	crean at the cursor
47 :	cell	fixed edjust	care check to see that the		e, w/1	te result rep. bl = 1,	wrate entry requeter
	le cab		divisor is not too his.	display_req	proc	маг	
	BOV DOM	b1,1	: If it is, divide both requeters : by 2 until the high word of the		nov	cx, 36	First scase what was here before
			; divisor is sare.	dispê:		sy cursor pos.cs	
		shift_res			call leep	write at our	
	pop cell	shift res			teop	disp#	swhich recister to display?
	jep	short od?			See	fire)	rbl = 6, display result remote
Ca1	cvd	ee, [di]	perform the davide. First the high word, then the low mae.		300 300	be, offset result required	
		word ptr 2[ss]		duepti			high
	mev	be.es se,2[di]	ofters the high word result in be	diep2:	BOY		plead requeter
					***	di, [be]	pelear du
	ja cab pob	ce el.*/*	:get operation back :see if division or med overstor				
	CEP 1s	efent			BOY CRP	eign,dl	pelmar mign flag
	BOY	ex,dx	jest consumder in in low word and		500	bese flag, 18 disp ns	is this a derival mode? inc, ship signed display of run isse if negative number
		ta,he (di),be	clear the high word.		300 600 300	di. d disp_os	yen, skip segation
	mov cop ja				200		yes, saip begation yes, negata mi.di
	emp	fixed flag. #	: If is fixed mode, davide : by iff to correct fraction			da,di	
	cop jes) by lee to correct fraction		Sec	di.dx	
		miend1			-	short disp of	
				ginnert diel	. maper	stors.	
	now.	ch,1					
dend) :	cell		ters if odd & of secoling durbers	diap_st:		ch fined flan.d	case if in fixed mode
dend) :	mov cell cep jee	ch,1 fixed adjust sigh,1 mdend2 measts res	rees if odd 8 of megaline numbers rever camber, multiply done jds already pointing to result req	diap_st.	(au cmp	ch fixed flag, 0	;see if in fixed mode

PRODUCTIVITY

	14	diep nd		states are	DT - No	ffer address,	
	cwp for	65.3 disp_636	joherk for place to put desired pt	leastey: are	01 - 84	itter sontere,	
	pov jep	ebort diep_u51	swrite decimal point	ecreen_ope	proc	neer de	seems as and de-
diep_n30: diep_n31:	807		pliane we know were in fixed been,		pueb	***	,
ereb_sari	mov mov jep mov dec	e1,3 b2,*,*	; sat up for groupe of 3. ;eepecete decimal digite by e ","		push	adepter, 0	; sere entry parameter ; See if CGA, ie so disable it ; before writing to the screen.
diep_n6:	100	ebort dlep_n5	(Depending on the best were in,		500 0011	erreen_op1 cge_off db,window_row	
-	dec	hose flog.10	r set up the number of digits to r ownet between the seperators. For a base of 8 and 16 orporate	seress_op1/	BOY	dh, window row dl, window column	prow and column of window corner
	3# MOV MOV	diep_n31 b1,	; For a base of 0 and 16 orporate; by 6, for binary, separate by 0		BOT	bl,v page el,di	iget video page in 50
	mov	ei,4 heee flee,2	, ., .,,,,,		cell	videe_ptr bs_column adj	pere beffer address pet starting edgrees of window pload index register adjust
	ine	diep_n5		1	mo*	on, v sequent	
diep_m5:	obw		;Now that everything to set up,		pop	ai.1	; so or de later. el-d, acreen sove. el-1, restor
-	div	eh, e	; check if a separator in needed ; by checking for a remainder of		50	ecreen op2 m derpothing	peince this routine does both the
	jne	disp of	sero when dividing the digit count by the group number.		sebeca sebe	e eeinothing	restore, earel and derdi are
diep_m51:		write_bech	,, ,		SAP	de,ex short screen_opl	; ecraen eave end the ecreen restore, eared and devid are est to their proper eddresses, pecuse of this, make so resumptions on we end de in
propley dig disp_ns:	BOY	hx,bese_fleq ax,di	rafter ell thie, ite time to ; display the digit. Divide the	screen_op2: screen_op3:			
					eld	es,12	:12 lines to seve
	div mov	bu da.ex	; for each of the digite.	seress_op4:	pash	68 68,44	
	div	ex, ei			Leb	el.1	strenafer one line to buffer
	BOY	el, az az, dz	peave low word quotent pget remainder of division		24 864	erraen_op5	jedjust ei for mext line
	cmp 11		pronvert remainder to estin	ecreen op5:	190 edd	sbort screen_op4	redicet di for next line
		diep_n2 air, 37h		screen_opir	pop loop	CE	iget line count iget line count
diep oži	3#P	ehort diep_n3			000	ecteen_op4	; loop until done ; Bastore the serment registers
diep_o2: diep_n3: ;chesh to eec	0+11 1f we	write bech	:dieplay digit		pop	e estenda	
	See See	day of	odleplay digit spley, scheck for mere number in requeter		6002E	e descode el.0	off an excel the excess days them
	Cmp 394				jae	eccsen op? open_wlodow	; If we seved the sormen, drew the ; cele window into the ecreen.
		disp_el fixed_fleg.t disp_end cb,3	; ourse that at isset i sero has ; been displayed (3 for flood.) ; If so, exit loop.	ecraen_op7r	CRO		; If CGA, enable it before
	5e cep	cb, 3	; If ec, exit loop.		reli	erraen ope	; returning.
disp_end:	51 cmp	disp of each, d	; If the rumber displayed wee	ecrees opdi	ret		
	je dao		; negetive, write a "-" hefore	Wideo at r. o	alculat	as the offest into t	he widen memory orresponding to the row
	mov cell	my_cureer_pre	,	pestry: 60,			d to it in the registers given below.
diep_endi:	dell	001_0.1F00F				deo page	
	ret			video_ptr		deo page	
diepley_reg	ret endp	keeps track of the cus	reor when writing brokwards.	1 P7	prec nov	fear e1,160	counts the displacement by the
display_reg	ret endp cutine proc	keeps track of the cus	reng when writing brokwards.	1 P7	\$100 - 71	feer el,lif	/compute the displacement by the
disp_endi: display_req ;This small : write_back	ret endp coutine proc dec cell dec	keeps track of the cus	reor when writing hackwards.	1 P7	proc mov ect est sor add	feo page el,ise dl,i db,dh ex,dx	counts the displacement by the
diepley_req ;This small; write_beck	ret endp cotine proc dec cell dec rel endp	keeps trash of the our mear my_crasc_pos write_st_cut my_curesc_pos	reor when writing beolugade.	1 P7	prec mov ecl ecl sor add mov mov	near e1,160 dh dl,1 dh,dh ax,dx di,ee ex,1800h	counts the displacement by the
display_req ;This small : write_back write_back	ret endp entime proc dec cell dec rel endp	keeps trash of the our mear my_crasc_pos write_st_cut my_curesc_pos	tor is in.	1 P7	prec mov ecl erl sor add mov mov sec	near el,16e dh dl,1 db,dh ex,dx dl,ee ax,10eeh bb,bh	counts the displacement by the
diepley_req ythis small; write_beck write_beck ythepley most	ret endp entime proc dec cell dec rel endp	keeps trash of the out max my_cursor_pos write at out my_cursor_pos w what oase the calcula	Kor ie in.	yideo_gtr	prec mov ecl esl sor add mov mov acc ecl ecl	feer page el;;ife dl;; dh;dh ax;dx di,ee ex;1000h bh;bh	counts the displacement by the
diepley_req pThis small; write_beck write_beck primpley most	ret endp cotine proc dec cell dec ret endp - sho proc mov	keeps trash of the out max my_cursor_pos write at out my_cursor_pos w what oase the calcula	tog ie in.	yldwo_ptr	yree mov eul eel mov add mov ser eul edd ret eul edd ret endp	feer el,160 dl,1 de dl	compute the displacement by the Colleving equation:
diepley_req ythis small; write_beck write_beck ythepley most	ret endp cutine proc dec cell dec ret endp - sho proc mov mev inc	keeps track of the out near my_cursor_pos write_at_out my_cursor_pos w what case the calcul- neer Gr.vindow_row di.window_culume di.uindow_culume di.uindow_culume	stor ie in. Jaet condisesse of window corner jaere donn i row	video_ptr	yree mov eul eel mov add mov ser eul edd ret eul edd ret endp	feer el,160 dl,1 de dl	
diepley_req pThis small; write_beck write_beck primpley most	ret endp cutine proc dec cell dec ret endp - sho proc mov inc edd nov	keeps track of the Gar mar my cereor pos write at co: my_cureor pos w what case the celcular meer db, window_row db, window_row di, window_row di, window_row di, window_row di, window_row di, window_row di, window_row di, window_row di, window_row my	get coordinates of window corner jacks done 1 row jacks done 2 columns loof address of hose label table	yldwo_ptr	yree mov eul eel mov add mov ser eul edd ret eul edd ret endp	fees fees fees fees fees fees fees fees	
diepley_req ythis small; write_beck write_beck ythepley most	ret endp cetime proc dec cell dec ret endp - sho proc mov mov add mov mov	keeps trash of the out mar. my_series_pos write at out my_tures_pos w what nase the celouis ever dh.vindow_rou and indow_rouse di.126 bx, of feet have ptr av. bees_fire	ider is in. pat coordinates of window corner pare down row pad over 2F columns lood defines of them beat table	video_ptr	processor in the proces	Gros page finest field di, 1 di, 2 di, 4 di, 4 ex, 1560 bb, bb bc di, ex ex, 1560 bc di, ex ex, 1560 bc di, ex field di, ex ex, 1560 bc di, ex disable the OGA by	
display_req ;This small : write_back write_back	ret endp entime proc dec cell fec ret endp - sho mov mov mov mov mov mov mov mov mov mo	keeps track of the out max. Secret pos- write at out write at out my_tures pos- eser to be the calcul- tion of the calcul- divindow_row	of it in. just coordinates of window corner pance done lose pance done lose pance done lose plode deferes of hose behal table plode deferes of hose behal table plomp base and base were in pantic hits ower i	video_ptr video_ptr video_ptr	precessor sor sor sor sor sor sor sor sor sor	George Control of the	compute the displacement by the Colleving equation:
diepley_req ythis small; write_beck write_beck ythepley most	ret endp estime proc dec cell fec ret endp - sho proc mov mov and and sec ret endp - sho sec ret endp - sho sec ret endp - sho sec ret incomp - sho incomp - incomp - in	been trash of the outers mar my_termer_pos write at out my_termer_pos what hase the colori conserved db.window_row db.window_row db.yo feat hase ptr my_termer_pos di.yo down	ider is in. pat coordinates of window corner pare down row pad over 2F columns lood defines of them beat table	video_ptr video_ptr video_ptr	precessor of the second of the	despise 1,146 1,146 1,147	Compute the displacement by the Column Col
diepley_req ythis small; write_beck write_beck ythepley most	ret endp entime proc dec cell fec ret endp - sho mov mov mov mov mov mov mov mov mov mo	heaps trash of the our mass mass mass of the our mass of the out o	oder is in. just coordinates of window corner just one fine in our just own I now just own IP columns just of the interest of the interest just of the in	video_ptr video_ptr video_ptr	preed move cold self self self self self self self self	George Control of the	Compute the displacement by the Column Col
diepley_req ythis small; write_beck write_beck ythepley most	ret endp leatine proc dec reli dec reli dec reli dec reli endp lead mov mov mov line edd mov mov edd mov edd edd edd edd edd edd edd edd edd ed	keeps trash of the out mar. "y_curset_poe wy_curset_poe wy_curset_poe wy_curset_poe what hase the celoui- ment do.vindow_culan- culan- vindow_culan- culan- vindow_culan- culan- vindow_culan- culan- vindow_culan- culan- vindow_culan- culan- vindow_culan- culan- vindow_culan-vindow_culan- vindow_culan-vindow_culan- vindow_culan-vindow_culan- vindow_culan-vindow_culan-vindow_culan- vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan- vindow_culan-vindow_culan-vindow_culan-vindow_culan- vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan- vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vindow_culan-vind	per condinence of window conver part condinence of window conver part condinence of twen lead table fittle dow which have ver in small false over 1 liched convert in the condinence of the condinent of	video_ptr video_ptr video_ptr	pred mov col est pred	despise 1,146 1,146 1,147	Compute the displacement by the Column Col
diepley_req pThis small; write_beck write_beck primpley most	ret endp leatine proc dec cell dec ret endp - sho mov mov mov mov end end mov end end end end end end end end end end	Neeps train of the out man of the outer post of the pro- sent of the outer post of t	of a la- jest coordinates of window corner jest coordinates of window corner jest own 18 columns joud address 18 columns joud	video_ptr video_ptr video_ptr repa off rea equ_off; equ_off;	preceded and proceded and proce	one page el.ise	prompted the displaneaux by the following specimen
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endpendine proc dec cell dec ret endp - sho proc mov inc edd mov mov eel cr endp inc edd mov mov eel cel endp inc edd edd edd edd edd edd edd edd edd ed	hepp trail of the out mark ones, pos- wills at for wills at for any curser pos- ser. The control of the desired pos- er. The control of the desired pos- tion of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the desired post- tion of the control of the control of the control of the desired post- tion of the control of the control of the control of the desired post- tion of the control of the control of the control of the desired post- tion of the control of the control of the control of the desired post- tion of the control of the control of the control of the control of the desired post- desired post- desired post- desired post- desired post- desired post- desired post- desired post-desired post-desir	one in in. just coordinate of wardow corner passe down i now passe down i passe now passe down passe if final pass if final pass if final passe if final	video_ptr video_ptr video_ptr video_ptr video_ptr cop_off cop_off cop_off cop_off cop_off cop_off	preceded and proceded and proce	does page 1,140 1,140 1,141 1,1,1 1,1 1,1,1	prompter the first-learner by the 1 Statement of th
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret enthy entline proc celli dec celli proc ret enthy proc ret enthy proc enth proc en	hope train of the out market of the out market of the out of the o	per condinence of window conver part condinence of window conver part condinence of twen lead table fittle dow which have ver in small false over 1 liched convert in the condinence of the condinent of	video_ptr video_ptr video_ptr repa off rea equ_off; equ_off;	proce sort processor proce	one page el.ise	prompts the finishment by the 1 filler prompts of the prompts of t
display_req prist small; write_beck write_beck write_beck prist_prist_ prist_prist_ prist_prist_ display_bene	ret errigionaliae proc errigionaliae dec errigionaliae mov	heaps train of the out market processing to the control of the con	one in in. just coordinate of wardow corner passe down i now passe down i passe now passe down passe if final pass if final pass if final passe if final	video_ptr video_ptr video_ptr video_ptr video_ptr cop_off cop_off cop_off cop_off cop_off cop_off	proce sort processor proce	one people of the control of the con	prompted the deplement by the collection of the
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endprocedure procedure procedure cell dec cell procedure proce	hope train of the out mark of the out mark of the out mark of the out of the	part conditions of vision commercial programs of vision commercial programs of vision commercial programs of the programs of t	video_ptr video_ptr video_ptr video_ptr video_ptr cop_off cop_off cop_off cop_off cop_off cop_off	- yi processor on the processor of the p	Company Com	prompted to designment by the control of the contro
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endproce endproc decl decl decl decl endproc endl proc endproc endl proc end proc end proc end	here train of the out of the county former post of the county former p	order in the constitution of transfer engine	video_ptr video_ptr video_ptr pea off roo equ_eff equ_eff equ_eff equ_eff equ_eff	- yi processor on the processor of the p	one people of the control of the con	prompted the deplement by the collection of the
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endproce endproc decl decl decl decl endproc endl proc endproc endl proc end proc end proc end	here trash of the out of a content pos- write at the out- write at the out- write at the out- write at the out- down out- down out- toon	per tominame of value commu- per tominame of value commu- per tominame of value commu- per tominame of the community of the production of the community of the community of the community of the community of the community of the production of the community of the community of the community of the community of the community of the production of the community of the production of the community of the production of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of the community of	video_pit video_pit video_pit pea off rou pea_off pea_off ope_off ope_of	- yi proce more col more col add more sed col add add more sed proce in teet je ech more in teet je ech more in teet proce in teet proce in teet proce in teet more in teet in teet more in teet more in teet in teet more in teet more in teet more in teet more in teet more in teet more in teet more in teet in teet more in teet in t	despending of the control of the con	prompts to displacement by the control of the contr
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endgreet	hope trash of the out of the property of the p	And in the contract of the con	video_ptr video_ptr video_ptr video_ptr op_eff op_eff op_eff op_eff op_en op_en op_en	- yy proc mor col mor col mor col mor sed mor sed mor sed sed mor sed sed sed sed sed sed proc in teet proc i	one page may if a graph of the control of the cont	prompted to designment by the following the
dieplay_req This Meal! ; write_beck erite_heck erite_heck erite_heck erite_heck erite_heck	ret endprocties endprocties for	here trash of the out of the county for the county	And in the contract of the con	video_pit video_pit video_pit pea off rou pea_off pea_off ope_off ope_of	- yi proc more col col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col col more col col more col col more col col col col col col col col col col	one page of the control of the contr	Company to the designment by the Company to the Com
display tes The small s The sm	ret endgreutime en	hope trash of the out of the property of the p	And in the contract of the con	video_ptr video_ptr video_ptr video_ptr op_eff op_eff op_eff op_eff op_en op_en op_en	- yi proce entry entry and and and and and and and and and and	one page and the page of the	prompted the designment by the control of the contr
displey_teq Tribs_Sed; write_beck vrite_beck prispley_neck prispley_bene displey_bene	ret endgecential ender endgecential ender endgecential en	hope trash of the out of the county of the c	And in the contract of the con	video_ptr video_ptr video_ptr video_ptr op_eff op_eff op_eff op_eff op_en op_en op_en	- yi proc more col col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col more col col more col col more col col more col col col col col col col col col col	one page of the control of the contr	Company to the designment by the Company to the Com

UTILITIES

		619. al	used it out to souble bestoard	1		cn. 62	-62 observeders to write
	cli	******	seemend Interrupts		20Y	en,62 eh,beeder_ettr	
	move	*1.785	jest not velue	openi r	ledeb		get the text character
	eut	20h, e1	pend not to 9259		Rteew	eren1	perite cher/ettr peir to vide
	ret		Sesente Terrettribre			eb.border ettr	ide Lidgemost column
reset	endo					el,179	to this come
Z					edd	di.column edi	indicat Di for next line
DATEST DE	WILLES	the designated charmets	r directly to wideo memory.		ret	di,column_edj	indiguet Di for next line
artry on,	U PO	ribate, character		write header			
				prite o lim	of che	erectore to the window	
tpst_ther	prec .	di		write_lime	proc	neaz co	
	bear	do do			#Ecew		jurise left and cherecter
	poeb	**			mov	cn,42	
	807	ee,v_eegment			rep	en, bn etoew	jest middle characters from b
	post.	bx errothing				ex-de	out right and character from
	pueb	**			stow		.,
	BOY	hl,v_pege video atr	iget page in #X		edd	di,celumn_adj	jedjest St foe mext line
	cell	video_ptr edepter.#	icalculate eddress to write to		pop	ex	
	jne	output)		write line	endp		
			:qet CGA Stetus Reg:eter eddress ;weit cetil boris. retrece done	Januarana.			
Spulls	IA test	el,de	; well cetil boris. retrore done		w up -	ecroli wandow up 1 lane	
	test	el,1 outputl		ecro11 wysder	2018	BH 07	
	ime cla		(suspend interrupts during write			**	peers as
tput2:	Tu.	el,de	post for hest borrscetel setrors		Preb	el. · ·	
	teet 50	el,1 output?			BOY	ah.test_ettr	:First remove cursor by writh
tput3:	24 pep	estpot2	;get cherecter end ettribute		cell	write_at_cur	
.,					now add		;pot upper left occeer to CK
	+1.1				add		
	pop pop	te es	Restage registers	1	NOV LEC	el, window column	
	P=P	eercode			BOY	dr.rn	out lower right corner in DE
	pop	de			100 100	40.5	
	pop	ds			+64	d1,41	
tout char	ret				BOY	eb, 6b	:bine neroll up function
					BOY	bb.test ettr	
PER KINDOW	dreve !	he window burder onto 1	he screen. Cheracter/sttrabute		int	16b -	prell bice
		ctly to wideo memory to	r took display speed.		c+11	set_cureor	
um Window	25.00	mar.		1	pap	en .	
	BOY DOY		iget coordinates of window corner				: done
	mov.	dl,window_column		ecrol1_window	endp.		
	post.	••	mount ES to video buffer	eet_cureor	proc	di,window column	that up ay man career location
	80V	er, v coppert			BADY.	dh,window_column	; fot up my own careor location
	414		poleer DF for string opesetions		nov edd		
	BOY	bl,v pege bb,b5	iget widen pege in 68		+44	db,7	
	cell		scalculate starting edifess		rel	my_curece_pos.dx	
write the t	op line			eet careor	endp		
	BOY	01,310	ral - left end cherecter	1			
		ab,border_ettr	; not ettribute ;bl = middle 42 characters		edirect	to the seyboard interrup	t, then reserves enough memory
	BOY	b1,196 d1,191		ithe program			
	BOY		jbl = middle 42 characters jdl = right end character jeogy the herder attribute		proc r	TANK	
	BOY BOY	d1,191 bh,sh db,sh		ithe program	proc r	do,offeet program	; pingley instellation message
to the wind	mov mov mov cell	dl,191 bb,sb db,eb write_line write_ne	idl = right and character jeogy the herder attribute	initieline	proc r nov	ds,offeet program eb,9 21h	,
the wind	mov mov mov cell ov head	dl,191 bh,sh db,sh write_line or line.		initieline	proc r nov nov int	ds,offeet program eb,5 21h hee of thie program in	,
	mov mov cell ve head mov cell	dl.191 bh.sh db.sh write_line or line. el.offest hender_text write header	idl = right and character peopy the berder attribute spoint BT to text of line	initieline	proc r nov 1M ther cop	ds,offeet program eb,9 21h piee of thie program in he he	,
	mov mov mov cell ov heed mov cell to next	di,191 bh,sh db,sh write_line rr line ei,effest hender_text write hender 10 lines (no text) to	Idl = right end cherecter recept the herder attribute spoint EI to text of line he display.	initialine	proc r nov nov int	ds,offeet program eb,5 21h hee of thie program in	numbery.
	mov mov cell ov heed mov cell to next mov	dl.191 bb.sb db.sb write_line rr line. el.effect bender_text write bender 18 lines (no text) to t cs.6 el.179	Idl = right and character lengy the herder attribute ipoint BI to text of line he display.	initieline	proc r nov 1.05 ther cog xor nov 1.00	de, offeet program db,9 2th 2th siee of this program in ba,bu word pir (entry), bn ab,co be	numbery.
	mov mov cell ov heed mov cell to mext mov mov	dl.191 bb.eb db.eb write_line or line el.effeet bender_text write_basder 18 lines (so text) to t cs.6 el.179 eb.border ettr	adl = right and character recept the herder attribute speint st to text of line he display, 16 lines to do 100 lettmoet column	initialine	pred s Boy nov 1.05 ther eeg xor mov 1.00	da, offeet program db, 9 31b), see of this program in bx,bx werd ptr [evtry], bn 4b, re be en.bx	number, jeter: seerch et eegment p jeterik ment segment jeterik ment segment
	mov mov cell ov heed mov cell to next mov	dl.191 bb, sb db, sb db, sb vrite_line r line; ei, difest bender_text write basder 18 lines (no text) to 1 cm, 4 al.179 sb, border_etr bl.12	right end charectar propy the herder attribute lipoint Br to tast of line he display, 16 lines to do 1do lefunet column 1do ment 38 columne (bleck)	initialine	pred s BOY DOY 1.05 ther eeg zor BOY 1.00 Cup	da, offeet program db, offeet program db, p 21h ba, bu werd ptr [entry], bn 48,49 be em, bn no concise	number, jeter: seerch et eegment p jeterik ment segment jeterik ment segment
	mov mov cell ov head mov cell to next mov mov mov mov	d1,191 bh,sh db,sh db,sh db,sh write_line reline. el,offest hender_text write_hender 19 lines (no text) to 1 ca,6 el,179 eb,berder_etr bl,22 bh,text_str di.179	adl = right and character recept the herder attribute speint st to text of line he display, 16 lines to do 100 lettmoet column	initialine	pred s Boy nov 1.05 ther eeg xor mov 1.00	what da, offeet pregram eh.9 21h bise of this program in bac,bu weed pir [entry], bn aAn.es be sal.bn no cogise e-1,bn	memory, jetort storch et eegment princip storch ment eegment jeld we Ichd corretien? jeds enly 1 copy in memory jees enly 1 copy in memory jees ee eegment pointer
ow write ti	mov mov cell ov heed nov cell to East nov mov mov mov mov	d1,191 bb,sh db,eh db,eh db,eh write_line r line r line line(so text) to 1 c0,4 20 lines (so text) to 1 c0,4 20 bb,border ettr b1,12 bl,test ettr d1,17 d1,175	right end charectar propy the herder attribute lipoint Br to tast of line he display, 16 lines to do 1do lefunet column 1do ment 38 columne (bleck)	initialine	proc s nov int ther con mov int cup je nov ace je	near dn.offset program sh.9 21h blee of this program in buc,bu weed pir (swiry), bn sh.6 a.h.49 be en.bn no.cogise es.bu semnothing	memory, jetert sterch et economi p jetert sterch et economi zebock ment segment jedid we fled curestvert jee, only 1 copy in memory juse et es especat pointer jed le the offest pointer
ow write ti	mov mov cell ov head mov cell to next mov mov mov mov mov cell	d1,191 bb,ab db,eb write_line write_line write_hader text write hasder 10 lines (no text) to 1 ca,6 el,179 bb,tonger_ettr bi,32 db,tonger_ettr db,ab write hade db,tonger_ettr db,ab write line	all = right and charecter roops the berder stribute spoint ST to taxt of line be display, if lines to do all between column and sexts of column and columns and column	initialine	proc s nov nov int her cop nov her in in in in in in in in in in in in in	what do, offeet program eh.9 21h like of this program in hac,bu weed pir [entry], he as.00 be do, bo	memory. jeter: seerch et sequent jeter: seerch et sequent jed current segment jed current segment jew ee ee segment pointer jed is the offset pointer
ow write ti	mov mov mov cell ov head mov cell to zext mov mov mov mov cell loop	d1,191 bb,ab db,eb,line fb,eb,line re line; el,effest bender_text write basder 18 lines (no text) to 1 a,6 ab,border_ett bb,text_str d1,179 db,ab wxite_line	all - right and character proper the brider strikular ipoint for to taxt of line he display. If lines to do the britant column jdc max 19 columns (block) jdc rightness column lines and lines to the brider lines and lines and lines to the brider lines and lines to the brider lines and lines to the brider lines and lines and lines to the brider lines and lines and l	initialine	prod r nov 1.nt lber cep 20.2 nov 100 100 mov 4002mm nov nov	near dn.offset program sh.9 21h blee of this program in buc,bu weed pir (swiry), bn sh.6 a.h.49 be en.bn no.cogise es.bu semnothing	permony, search of occupant \$ jet of current segment jeted to segment jeted the segment jeted we find ourselves? jete, och; I cop; in memory jete oe os organt pointer jed is the offest pointer jed by a same place in both in the
ow write ti	mov mov cell ov head mov cell to rext mov mov mov mov mov mov eell loop cepe	d1.99 bb, sb db, sb, line et line, el, eff set honder_tex write_honder 10 line (so caxt) to to ca, f el, 179 db, lost, etr dl, 179 db, lost, etr dl, 179 db, about etr write_line speeds set[ve cross i el, 199	all - fight and character imposes the fact of line be display. if lines to do job lettanet column job and 30 columne (blesh) job cighteest column job man 30 columne (blesh) job man 31 columne (blesh) job man 31 columne (blesh)	initialine	proof r nov 1nt ther eeg xnz mov nov 1ne cup je mov accup nov nov cod cod nov cod nov cod cod nov cod	what do, offset program sh, 9 21h hase of this program In ha, ha werd pir (entry), he dole no. he no. copise es, ha e es not find the short of the s	per carrent segment pas carrent pas carre
ow write ti	mov mov cell ov heed mov cell to next mov mov mov mov mov mov mov mov mov mov	di.99 bb.sh and direct line re line; el.ef(est header text write hasder 18 lines (no Caxt) to 1 4.179 sh, horder ettr bi.32 bb.sess_ettr do.ab wate_line open ate the nettw ecrees 1 ett line open ate the nettw ecrees 1 ett line open	all - right and character proposed before titribute ipolet BT to taxt of line he display. If lines to do and lettunet column plose max 13 columne pitent; pdo rightness column plomp pottl finanched prom the belt text.	initialine	pred f nov	meant danoffeet program and the program and th	memory, jet out search at dequent \$ jet cutrent expent otherk med segment old or float correliver; jet, edgy in memory jet, edgy it offers pointer jet is the passe of the pointer jet is the offers of the pointer jet is compare, when is sold, and
ow write ti	mov mov env cell ow head mov cell he fext mov mov mov mov eell leepe mov eell eell eell eell eell mov mov mov mov mov mov mov mov mov mov	di.99 bb.sh and direct line re line; el.ef(est header text write hasder 18 lines (no Caxt) to 1 4.179 sh, horder ettr bi.32 bb.sess_ettr do.ab wate_line open ate the nettw ecrees 1 ett line open ate the nettw ecrees 1 ett line open	all - fight and character imposes the fact of line be display. if lines to do job lettanet column job and 30 columne (blesh) job cighteest column job man 30 columne (blesh) job man 31 columne (blesh) job man 31 columne (blesh)	initialine	pred f Boy nov 1.01 ber eeg xoz mov 1.00 cup jo mov xov mov xov mov nov mov mov mov mov mov mov mov mov mov m	seed da.offeet program as b. 9 sh. 10 sh. 9 sh. 10 sh.	memory, jet out search at dequent \$ jet cutrent expent otherk med segment old or float correliver; jet, edgy in memory jet, edgy it offers pointer jet is the passe of the pointer jet is the offers of the pointer jet is compare, when is sold, and
ow write ti	mov mov mov cell ov heed mov cell to rest mov mov mov mov mov mov mov mov mov mov	d1.99 block between the control of t	all - fight and character imposes the fact of line be display. if lines to do job lettanet column job and 30 columne (blesh) job cighteest column job man 30 columne (blesh) job man 31 columne (blesh) job man 31 columne (blesh)	initialine	pred f nov nov 1/1 leer eeg 202 nov nov 400220 nov 400220 nov 400220 nov 1/1 1/1 1/1 1/1 1/1 1/1 1/1 1/1 1/1 1/	where dath of the program in a con- pose of the program in backs where of the program in backs where of the (witry), be also on the con- pose of the program in a con- pose of the con- the con- pose of the con- the	process search of organit 8 ped current organit arbook most organit arbook most organit arbook most organit arbook most organit process organi
ow write ti	mov mov cell cell cell to be zext mov mov mov mov mov sell leepe mov mov mov cell leepe mov mov cell leepe mov mov cell mov mov mov mov mov mov mov mov mov mov	di.99 bback board board write_lies **rite_lies **side_lies bedder_text **side_lies bedder_text **side_lies **side_lie	aft - right and character semps the header strictions special at a case of line he display. So displays do do before column job maxt 30 columns (hierb) job maxt 40 colum	initialine	pred f nov	where da. offset program In 21h 22h 22h 22h 22h 22h 21h 21h 22h 22h	process search of organit 8 ped current organit arbook most organit arbook most organit arbook most organit arbook most organit process organi
ow write ti	mov mov mov cell or head mov mov mov mov mov mov mov mov mov mov	di.99 boach write, line or line; or lin	all - fight and character imposes the fact of line be display. if lines to do job lettanet column job and 30 columne (blesh) job cighteest column job man 30 columne (blesh) job man 31 columne (blesh) job man 31 columne (blesh)	inthe program initialine jobeck for at find_knope	pred f Boy nov	where da, offeet program and a sub-program and a	process asserts at expount # 1 per current segment prior to many segment prior to many segment prior to many segment pointer prior to many segment pointer prior to see a segment prior to see a seg
ow write ti	mov mov cell cell cell to be zext mov mov mov mov mov sell leepe mov mov mov cell leepe mov mov cell leepe mov mov cell mov mov mov mov mov mov mov mov mov mov	di.55 bits write, line write, line write, line write, line write, basder write, basder etc. line write, basder etc. line write, basder etc. line write, basder etc. line write, line writ	and - right and character semp table house's trichicles problet for to text of line he display, of lines to do (abs lettones colone job must 30 columns (blesh) job must 31 columns (blesh) job must 31 columns (blesh) job must 15 columns (blesh) job must 15 columns (blesh) job must 16 colone lines to text corner lines the house column posies 21 to text of line	initialine	pred f nov	where da. offset program In 21h 22h 22h 22h 22h 22h 21h 21h 22h 22h	process asserts a sequent 8 jest current separat
ow write ti	move move cell to the next move move move move move move move move	displ displ displane	off - right and observed grains of to text of line he display. I lines to text of line he display. I lines to text A lines to text I li	inthe program initialine jobeck for at find_knope	pred f nov nov nov nov nov nov nov nov	where drawt program In Man San San San San San San San San San S	process asserts a sequent 8 jest current separat
ow write ti	movement and a service of the servic	d.191 with the depth of the dep	all - eight and observation of the control of the c	inthe program initialine jobeck for at find_knope	prod f Boy Boy Lift Life Life Life Life Life Life Life Life	wheel of the program in the program	permitting the property of the
ow write ti	mov mov mov cell ov head mov cell to mov mov mov mov mov mov mov mov mov mov	d.193 d.193 d.194 write_line write_line d.105	and a right and observation of the right of	inthe program initialine jobeck for at find_knope	prod f nov	where the program is a second of the program in the	permitting the property of the
ow write ti	move move move move cell move move move move move move move move	d.193 dh.ed or the degree of t	and a right work of the control of t	inthe program initialine jobeck for at find_knope	prod f nov nov nov life f of nov life f of nov life f of nov nov d of nov nov nov f f of nov nov f f of nov nov f f f of nov f f f of nov f f f of nov f f f f of nov f f f f f f f f f f f f f f f f f f f	where the program is a second of the program in the	permitting the property of the
ow write ti	more more cell or head more cell or head more cell or more more more cell long long more more cell long long long long long long long lo	d.193 d.193 d.194 d.195 d.196	and a right and observation of the right of	inthe program initialine jobeck for at find_knope	prod f Boy Boy Life eq	where desired program in the program	per control segment green control to the control to
ow write ti	move move to the control of the cont	d.193 d.193 d.194 d.195 d.196	and a right work of the control of t	the program initialise initialise jobeck for of find_loop; mo_copiess	prod # mov nov nov nov nov nov nov nov nov nov n	one design program design program (1) the prog	printer amount of sequent per carrier amount of the control of the
ow write ti	move move cell in the next move move the move cell in the next move move move move move cell in the next move move move move move move move move	d.193 d.193 d.194 d.195 d.196	and a right work of the control of t	inthe program initialine jobeck for at find_knope	proc s mov nov nov nov nov nov nov nov nov nov n	where the program of	parties assembly appendix a sequent a popular converse segment of the first contrained by the first co
ow write ti	move move cell move move the move cell move move move move move move move move	d.193 d.193 d.194 d.195 d.196	and a right work of the control of t	the program initialise initialise jobeck for of find_loop; mo_copiess	prod to now tank tank tank tank tank tank tank tank	where the state of	print the body of property of the body of
end; write line : write the h	move move cell in the next move move the move move move move move move move mov	d.193 d.104 d.105 d.106	and a vigin was defined to the control of the contr	ith program initialine jobesk for at find_loop; to_copies; zEnst by TSS	proc s mov nov nov nov nov nov nov nov nov nov n	where the program of	control masses a segment of the control masses and the control masses are control masses and the control masses and the control masses are control masses and the control masses and the control masses are control masses and the control masses are control masses are control masses and the control ma
need; trite line : Trite the h	move move cell in the next move move the move move move move move move move mov	d.193 d.104 d.105 d.106	and a vigin was defined to the control of the contr	the program initialine	priod in more than the control of th	was a company of the program of the	personal management of the control o
need; trite line : Trite the h	move move cell in the move cell in the move cell in the move move cell in the	d.191 d.192 d.193 d.196 d.	other (10% and recently product of the test of line to the collection of the collect	the program initialine	prior i priori prior i prior i prior i priori priori priori priori i priori pr	where deficient program in the progr	personal management of the control o
end; write line : write the h	move move cell in the next move move the move move move move move move move mov	d.193 d.104 d.105 d.106	and a vigin was defined to the control of the contr	ith program initialine jobesk for at find_loop; to_copies; zEnst by TSS	priod in more than the control of th	was a company of the program of the	personal management of the control o

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Multiplying Two 32-Bit Numbers

						1234 * 9ABC	5678 ·			Original 32-bit operands
DEF0	*	5678	=			4B4D	2080		_	
DEF0	*		=		OFDA	28C0				Results of intermediate 16-bit
9ABC	*	5678	=		3443	B020			- 11	multiplications
9ABC	*	1234	=	0B00	A630			_		
				0800	EA4D	1242D	2080	-	OBOOEA4E	242D2080 == 64-bit resu

Because neither the 8088 nor the 80286 can multiply two 32-bit numbers directly, a different strategy must be used. Each 32-bit operand is divided into two 16-bit portions, separate multiplications are performed, and the results combined.

usive divisions by 2, the resulting quotient will be unaffected. Another problem with division is the fact that the quotient must finit once word. The MSRS places the quotient of a 16-bit divide into AX and the remainder into DX. If the quotient is larger than 16 bits, an interrupt will occur, indicating a divide overflow. To avoid this problem. CALC performs the division in divide the divide into AX and the remainder into DX. The problem is the divide of the

 CALC stores the quotient from the first divide and loads in the dividend for the lowword divide. vide. Since the microprocessor leaves the remainder of the first divide in DX, the only thing CALC does is to store the quotient from the first divide and load in the dividend for the low-word divide. After the low words are divided, the quotient is stored and the divide is complete.

Yet to be discussed is the problem of signed arithmetic. CALC stores numbers in 2's complement form. This means positive numbers are represented by the values 0-7FFF FFFFh. As you would expect, 0h = 0, 1h = 1, up to 7FFF FFFFh =

00 NEN -					e.com						DATA	9,	٠,	٥,	2,	٠,	٠,	٠,	٠,	-
19 OPEN "Calc.CON" AS \$1 LEN = 1									DATA	9,	9,	٠,	72,	161,	120,	22,	22,	25		
29 FIND \$1.1 AS AS									DATA	22,	22,	22,	66,	105,	110,	67,	114,	50		
28 CERCEAUN - 8									DATA	121,	22,	22,	76,	49,	116.	67,	109.	64		
146 POR I = 1 TO 225									DATA	22,	22,	22,	60,	161,		105,	100,	57		
	PERSON -										DATA	67,	100,	22,	78,	185,	120,	161,	100,	72
155 PRINT ".";								DATA	22,	22.	22,	104,	99.	111.	100,	22,	54			
	# 3 - 1										DATA	67,	110,	100,	22,	111,	114,	22,	22,	62
176	READ BY										DATA	120,	111,	114,	22,	161,	214,	114,		78
20	CHECKEU	× - CHE	CEEUN +	STTE							DATA	9.				12.	11.	9.	174.	1.0
	LINESUM										DATA	112,	7,	2,		164,	15,	31,	20,	24
200	IF CRIT	E 4 256	1 7788	LOWY AS	- CHRS	(BITE)					DATA	46,	49,	65,	41,	42,	46,	20.	67,	25
11.0	PUT #1										DATA	97.	166.	99.	117.	102.	97.	116.	111.	63
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131, 215, 63, 116, 44, 1166

744 (CALC.BAS commues)

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2,147,483,647. Negative numbers are represented by their absolute value below 0. That is, -1 = FFFF FFFFh, which is 0 decremented by 1. This means that -2 =FFFF FFFEh, -3 = FFFF FFFDh, and so on down to -2,147,483,648 = 80000000h. If you invert a number represented in 2's complement and then add 1, you have changed the sign of the number. Thus, for example, if you take -3 = FFFFFFFDh, invert the number (giving 0000 0002), then add 1, you get 0000 0003

To simplify the math routines in CALC, all multiplication and division are performed using positive numbers. On entry into the multiplication and division routines, the two numbers are checked to see if they are negative. If a number is negative, it is negated. The number of negative signs is counted; if the number is odd, the result of the division or multiplication is negated. For addition and subtraction, the opcodes work for 2's complement notation without any extra processing

For all math operations CALC checks for invalid results. In the cases of addition, subtraction, or multiplication, CALC checks for overflows in the result. For division CALC checks to make sure the divisor is not zero. When using the divide on-

 Since CALC stores all numbers in binary form, it is the responsibility of the display routine to translate the numbers into the proper base selected. The routine is quite simple.

code, it is important to detect the possibility of an error before it is allowed to occur. This checking is important because the 8088 will perform an interrupt 0 if an error is detected during a divide. When an error is detected, CALC aborts the operation and notifies you by displaying an error notation to the right of the in-

DISPLAYING NUMBERS Since CALC stores all numbers in binary form, it is the responsibility of the display routine to translate the numbers into the proper base selected. The routine to provide this translation is actually quite simple. The number to be displayed is copied into a temporary location and divided by the current base. The resulting quotient is saved. The remainder of the division is converted into ASCII and is displayed as the least significant digit. The stored quotient is then divided by the base again to produce the next digit to display. This loop continues until the quotient is zero, indicating that the entire number has been displayed. For decimal and fixed numbers, the register to be displayed is checked to see if it is negative. If the number is negative, the register is negated before being displayed, and a minus sign is appended to the left of the displayed number.

Fixed notation is simply a function of

valid result.



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If you use the Xmodem protocol. you can download CALC .COM directly, saving typing or downloading either the .BAS or the .ASM version. CALC.BAS, whether entered from the magazine at your keyboard or downloaded from PC-IRS, will automatically create CALC.COM when run once in BASIC, CALC. ASM, also listed both here and on PC-IRS, allows you to modify the program, but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

MASM CALC; LINK CALC; EXE2BIN CALC CALC.COM

Photocopy this page. Trim and hole-punch the copy and add it to your DOS manual.



CALC Command

Douglas Boling
Purpose:

1988/ No. 6 (Utilities A programmer's pop-up calculator with base conversion, bitshifting, logical operators, mod functions, and 32-bit number representation that also supports two-decimal fixed-place arithmetic calculations.

Format:

Remarks:

[d:][\path]CALC

CALC is a terminate-and-stay-resident (TSR) program that can be loaded either at the DOS command line or as a part of an ALTOEXEC BAT file. The Alt-S key combination (default) pops up a six line window for calculations; the Esc key restores the screen to its previous condition. The program accommodates automatically to monochrome, CGA, EGA, or VCA displays

Any number on CALC's entry line can be successively converted to headedmal, binary, orda, or decimal default) notation by pressing F1. Mixed-base calculations are supported, and the +y, -in at / function conventionally so long, and the supported of the they -in a function conventionally so long, and the supported of the they can be supported on the supported of the supported of

CALC uses full 32-bit number representation and so can be used for address calculations. The function keys 78, P4, and F5 perform logical AND, OR, and XOR operations between two numbers. F6 performs a NOT (invert) function on the number entered. F7 shifts bits left and F8 shifts right. F9 is a change-sign key, and F10 clears the entry line. To clear the calculator field, press Shift-F10.

Instructions on modifying the default hotkey and colors are presented, with appropriate tables of possible values, in a sidebar to the main article.

the enter number and display number routines. Internally, the number is represented the same way as the other bases. The only adjustments in the math routines are in the multiplication and division routines. In the multiplication routine, the final result is divided by 100 to correctly place the product in relation to the decimal point. For division, the dividend is multiplied by 100 before it is divided. This multiplication CALC is a utility you can quickly come to be dependent upon. Even as I was developing CALC, I was using earlier versions to translate decimal to hex

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The IBM Personal Computing Catalog and perform bit shifts.

makes room for a two-digit fraction. When a number is converted from integer decimal to fixed decimal, the number is multiplied by 100 to allow for a fraction. When a fixed number is converted to an integer, the number is divided by 100 to truncate

the fraction

CALC is a utility you can quickly come to be dependent upon. Even as I was developing CALC, I was using earlier versions to translate decimal to hex, add numbers, and perform bit shifts. By looking at the assembly language code, you can gain some insight into how today's TSRs examine the current PC environment. More may be learned about the ins and outs of 32-bit math. Finally, by examining the CALC utility's change base routine, you can see that with a little thought, big memoryhungry compare-and-jump-trees can be avoided. Mostly, though, I think you'll just be satisfied with having CALC there when it is needed.

Douglas Boling is an electrical engineer who has been involved in the design of computer hardware and software for 11 years.

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Os/2 THREADS AND HIGH-LEVEL LANGUAGES



Using OS/2's multiple threads in C programs presents potential but soluble problems. When it comes to the C library functions, the old specter of nonreentrancy haunts us again.

ometimes the documentation that accompanies the OS/2 Software Development Kit can be a little scary. Here's a warning appended to the description of the DosCreateThread function:

High-level languages, run-time libraries, and stack checking may sewerely limit or eliminate the ability to call DosCreateThread directly from a high-level language program.

It's a good thing I didn't mention this in the last issue, or we might never have attempted to call DosCreateThread from a C program!

As you'll discover in this column, there is good reason for the warning. But I remain convinced that multiple threads can be created in C programs provided the programmer is alert to the potential problems. It also helps if the programmer has a good background in assembly language and is familiar with the assembly language and is familiar with the C ibrary functions.

SAME CODE, OTHER THREADS In last issue's column we looked at two programs that created a second thread of execution. Let's take another step forward.

The QUADRANT program shown in Figure 1 creates four additional threads of execution. Each of these additional threads uses the same thread function, which is called ThreadFunction.

QUADRANT uses the four threads to draw and erase rectangular "spirals" continuously in the four quadrants of the

QUADRANT.C .- 08/2 Program that Runs 4 Thresds Using One Thread Function (C) 1988, Eiff Communications Company
FC Magazine * Programmed by Charles Petrold, 11/87 #include <descalls.h> #include <subcalls.b> #define min(a,b) ((a) < (b) ? (a) + (b)) void for ThreadFunction (void) ; mean () unsigned int struct KeyData for (i = 0 ; i < 4 ; i++) if (DOSCREATETHREAD (ThreadFunction, 47hreadID [i], ThreadStack [i] + 1024] puts ("OUADRANT: Could not create thread") : return 1 : KEDCHARIN (4kd, 0, 0) return 0 : *pragma check etackvoid for ThreadFunction () atetic struct ModeData ad ; ThreadNumber = 8, NumRep ! NioRow, MaxRow, MisCol, MaxCol ! MyThreadNum, Cycle, Rep, Row, Col ! static ict unsigned int DOSENTERCRITSEC (1 : if (ThreadNumber == 0) md.length = eizeof (md) ; VIOGETHODE (4md, 8) : NumRep = (min (md.col, md.row) / 2 + 1) / 2 ; MyThreadNum = ThreadNumber : ThreadMamber += 1 :

Figure 1: OUADRANT.C creates four additional threads of execution based on the same thread

ENVIRONMENTS

screen. Each of these four threads uses a different character-the number 0, 1, 2, or 3-for drawing its own spiral.

The main thread (thread 1) calls Dos-CreateThread four times to create the four threads. Each of the four threads gets its own stack. The main thread then calls KbdCharln to go into hibemation until a key is pressed. Pressing any key terminates the program.

Each of the four threads has its own 80286 microprocessor state. This means that when OS/2 switches among these four threads, it must save the contents of the 80286 registers (including the instruction pointer and stack pointer) of the thread it's switching away from, and restore the contents of the microprocessor registers of the thread it's switching to. In this respect the threads can run independently.

But these four threads also access data stored in variables defined within Thread-Function and Display. The question we must answer is: How can the threads avoid clobbering each other when they reach for the same data?

STATIC AND AUTOMATIC DATA You'll notice that some of the variables within ThreadFunction are defined as static and some are not. The distinction is very important.

When you first start learning C, you learn that variables defined as static within a function retain data between function calls. That is, if a function sets a static variable to 55 during one function call, the static variable will still be 55 the next time the function is called.

A variable that is not defined as static is called an "automatic" variable. You can explicitly define a variable as automatic by giving it an auto or register type. Automatic variables defined within a function lose their values when a function is exited.

But these definitions are not quite adequate when dealing with functions used by multiple threads in an OS/2 program. A more helpful definition is this: static variables are stored in the program's data area, while automatic variables are stored on the stack or in registers.

For example, if you look at a disassembled C program, you'll find that the compiler creates a prologue and an epilogue for each function, like this:

```
DOSEXITORITSEC () ;
     MinRow = HyThraadHum > 1 7 md.row / 2 : 8 ;
     MaxRow = MinRow + md.row / 2;
MinCol = MyThrandMun % 2 7 md.col / 2 : 8;
     MaxCol = MinCol + md.col / 2 ;
     while (1)
           for (Cycle = 0 ; Cycle < 2 ; Cycle++)
                for (Rap = 0 ; Rap < NumRap ; Rap++)
                      Row = MinRow + Rep :
                      for (Col = MinCol+Rap ; Col < MaxCol-Rap-1 ; Col++)
                      Display (Cycle, Row, Col, MyThrasdfum) ;
for (Row = MinRow+Rap : Row < MaxRow-Rap-1 : Row++)
                            Display (Cycle, Row, Col, MyThreadNum) ;
                      for (Col = MaxCol-Rep-1 ; Col > MinCol+Rep ; Col--)
                            Display (Cycle, Row, Col, MyThreadMum)
                      for (Row = MaxRow-Rep-1 ; Row > MinRow+Rep ; Row--)
                            Display (Cycle, Row, Col, MyThreadMum) ;
Display (Cycle, Row, Col, Mum)
     int Cycle, Row, Col, Num ;
     char String [2] ;
     String [0] = (char) (Cycle == 0 7 Mum + '0' : ' ');
String [1] = '\x07';
     VIOWRICELLSTR (String, 2, Row, Col. 9)
```

```
PUSH BP
MOV BP. SP
SUB SP. XX
```

[body of function] MOV SP, BP

POP BP

RET

DOSSLEEP (SL) ;

(The prologue may be different if stack checking is enabled. When compiling for 80286 code, the first three statements can be replaced with an ENTER instruction. and the two statements preceding RET can be replaced with LEAVE.)

The value of xx in the prologue code is set equal to the size in bytes of the storage needed for the function's automatic variables. The automatic variables can then be referenced by negative offsets to the BP register relative to the stack segment, thus:

SS:[BP - offset] Parameters passed to the function are positive offsets to BP. By contrast, variables defined as static within a function have an

absolute address relative to DS (the data

You'll recall that each thread in a process has its own 80286 microprocessor state, its own 80287 math coprocessor state, and its own stack. For multiple threads in a process that use the same function, this has an important implication: All variables defined within the thread function as static are shared among the threads. Each thread, however, has its own private copy of the automatic variables. This is true not only for the thread function, but for all functions called by the thread function, such as the Display function in OUADRANT.

(Figure I ends)

In ThreadFunction, the variable ThreadNumber is defined as static. Each of the four threads addresses the same value in OUADRANT's data area when the threads access ThreadNumber. The MyThreadNum variable is not defined as static, which means that it's an automatic variable and is stored on the stack. In effect, each thread maintains its own My-ThreadNum variable on its own stack.

ThreadFunction contains the two statements

MvThreadNum = ThreadNumber :

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Because ThreadNumber is initialized to zero, the first thread that executes these two statements sets its own MvThread-Num to zero and increments Thread-Number. The second thread then sets its own MvThreadNum to I and increments ThreadNumber. In this way, each thread establishes for itself its own identity. The threads use the MvThreadNum variable to display the number to the screen.

The distinction between static and automatic variables is also observed when ThreadNumber obtains the dimensions of the screen by calling VioGetMode. The VioGetMode function is called only

· For multiple threads in a process that use the same function, each thread has its own private copy of the automatic variables

once-by the thread that executes the code the first time. The ModeData structure passed to VioGetMode is a static variable so that the second, third, and fourth additional threads can use the values set in the

structure. The simple rule is this: for threads, static variables are shared; automatic variables are private.

CRITICAL SECTION FUNCTIONS Once you begin using static variables within a thread function, you have to start thinking about what happens if OS/2

switches between threads at the wrong time Consider again, for example, those two statements from OUADRANT's thread

MvThreadNum = ThreadNumber : ThreadNumber += 1 :

function:

What happens if the first created thread executes the assignment statement but, before it has a chance to increment Thread-Number, OS/2 decides it's time to let the second created thread run for a while?

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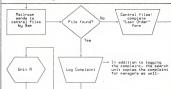
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Now the second created thread executes the assignment statement and—Yikes! The ThreadNumber variable is still equal to zero!

A series of statements like these is often called a "critical section." It is important for these statements to be executed without interruption from other threads in the same process.

To halt all other threads in a process during a critical section, you sandwich the critical section code between calls to Dos-EnterCritSec and DosExtiCritSec. This is shown in OUADRANT.C. DosEnterCrit-

 DosEnterCritSec and DosExitCritSec affect all the threads in the same process except the thread calling the functions.

Sec essentially says, "Everybody stop. I have something important to do." Dos-ExitCritSec says, "OK, everybody back to work."

In last issue's column I discussed Dos-SuspendThread and DosResumeThread. These two functions affect only one specifite thread. The DosEnterCritise and Dos-EatiCritise functions affect all the threads produced by the color of the near affect threads in other processes. The thread calling DosEnterCritise does not ensure for itself uninterrupted processing, because it can be interrupted if OS/2 switches to a thread in mother process.

THE THREAD STACK In the two programs in last issue's column, the stack used for the additional threads was an automatic array defined in main. The address of the end of this array (the top of the stack) is passed to the DosCreateThread function.

QUADRANT needs four stack arrays. Rather than taking them from the pro-



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gram's main stack (which, by default, is set to about 2K and is not quite large enough for four threads' stacks), I decided to define them as static arrays.

This decision has side effects. Normally, the function prologues in a program compiled with the Microsoft C compiler contain a call to a function that checks for stack overflow. Because the stack of the thread function is outside the program's normal stack, this check would about the program with an error message. Stack checking must therefore be inhibited in the thread function and in every function called from the bread function.

In QUADRANT this is accomplished with a pragma statement:

#pragma check stack-

You can also compile with the -Gs compiler flag to disable stack checking for the entire module.

We've seen how the thread's state, can be a chust of memory either from the process's main stack or from the process's main stack or from the process's static data rare. Either is OK because the stack and the static data are accupy the stack process of the stack and the static data area occupy the compiler generates code that accesses stack data relative to the Sas expert register and accesses static data relative to the DS segment register, the two registers have the same value and reference the same value and reference the same segment. More briefly, in C syntax:

DS == SS

It is also possible for a program to allocate a chunk of memory for a thread stack by calling DoxAllosSeg. At this point, however, everything gets a little hairy. That's because within the thread function—and in every function called from the thread function—the thread's data segment and stack segment are different. In other words:

DS I= SS

This little quirk does not prevent you from programming inc. (In fact, the problem of different stack and data segments also shows up in the programming of OS/2 dynamic link libraries.) But when you're writing code for multiple-thread programs, it certainly adds another layer of complexity. I'll discuss the implications in a later column on dynamic link libraries. ■ DOS programmers who have ventured into the programming of RAM-

programming of RAMresident utilities are well aware of what reentrancy problems can entail.

Conclusion: Avoid using DosAllocSeg to get a block of memory for a thread's stack if you're programming in a highlevel language.

USING CLIBRARY FUNCTIONS Ear-

lier, we looked at two lines of code in QUADRANT that we identified as a critical section. This raises a disturbing question: Could there be similar critical code hidden away in the middle of normal C library functions? Unfortunately, the answer is yes.

The problem involves reentrancy. DOS programmers who have ventured into the programming of RAM-resident utilities are well aware of what reentrancy problems can ential. DOS itself is a nonreentrant operating system; while one rogram call, another program cannor make a DOS function call without taking special precautions. The nonreentrancy of DOS has plagued the writes of RAM-resident programs for years. Most of the inflamous 'undocumented' Teatures of DOS involve various ways in which DOS programs such as PRINT get around the reen-

trancy problem.

OS/2 doesn't have this problem. You do not have to worry about calling OS/2 functions—even the same OS/2 func-

tion-from multiple threads.

What you do have to worry about is calling normal C library functions. Many C library functions are no reentrant: if one thread is in the middle of a library function call, another thread cannot call that same function ple in charge of the programming products about the problem with C library function reentrancy, they groan and admit that it has to be fixed. As we'll see, however, doing so may prove something of a challenge.

so may prove Sonkening on a citual negleing meeting the usual variables. If the function uses only stack variables, everyting is fine; each frenction uses only stack. For simple C functions, you can usually determine if the function uses static data determine if the function uses static data the a t-1 on function determines the length of a zen-reminated string. That's a fairly simple operation that can be done enterly with registers. Does at t-len use state data? Probably not, and in fact, it hereads is perfectly safe.

REENTRANCY AND RAND Of those library functions that are not reentrant, rand is a good simple example. Normally, successive calls to the rand function generate a pseudo-random sequence based on a seed. The initial value of the seed is 1, but it can be changed with a call to srand.

If you were to duplicate the rand function by writing it in C, it would look something like this:

unsigned long seed = 1 ; rand ()

seed=(@x343FDL * seed) + @x269EC3L;
return(int) (@x77FF & (seed >>16));

The seed is a static variable that changes with each call to rand. Thus, the same seed value is shared among all threads that call the rand function. That in itself is not a problem.

The problem occurs during the calculation. The function loads the value of the seed from memory, does a 32-bit multiply, then a 32-bit add, and stores the result back in the variable seed. If this calculation were interrupted between the load and the store by a call from another thread to rand, the two function calls could return the same "random" number.

Storing the new 32-bit value back in memory requires two MOV instructions. If OS/2 switched to another thread between these two MOV instructions, and the second thread called rand, then that rand call could use a seed that was half

ENVIRONMENTS

```
ALPHSOUP.C--OS/2 Program that Runs 26 Threads Using One Thread Function
                  (C) 1988, Ziff Communications Compa
                  PC Megazine * Programmed by Cherles Petrold, 11/87
#include <doscelle.h
#include <subcells.h>
void for Threedrunction (void) :
main ()
     static unsigned cher ThreadStack [26][1024] /
                          i, ThreedID [26];
kd;
     unsigned int
     struct KeyDate
     for (i = 0 ; i < 26 ; (++)
          if (DOSCREATETHREAD (Threedfunction, aThreedID [i],
                                ThreedSteck (i) + 1024))
               puts ("RANDQUAD: Could not creete threed") ;
               return 1 :
     KEDCHARIN (&kd, 0, 0) ;
     return 0 a
spreque check eteck-
unid for ThreadFunction ()
      static struct ModeDate md :
                              ClearCell [2] = " \x87" ;
                             ThreedNumber = 0 ;
MinRow, MexRow, MinCol, MexCol ;
     stetic int
     uneigned int
                              MyThreedNum, Row, Col;
     DOSENTERCRITSEC () ;
      if (ThreedKumber == 0)
          VIOSCROLLUP (8, 8, SXFFFF, SXFFFF, SXFFFF, ClearCell, SL) ;
           md.length = sizeof (md) /
           VIOGETHODE (4md, 0) ;
     MyThreedNum = ThreedNumber /
      ThreedNumber += 1 ;
     DOSEXITORITSEC () /
     Row = SafeRend () % md.row ;
Col = SefeRend () % md.col ;
      while (1)
           Row = (Row + Sefekand () % 3 - 1 + md.row) % md.row ;
           col = (Col + SefeRand () % 3 - 1 + md.col) % md.col ;
           Diepley (8, Row, Col, MyThreadNum) ;
           DOSSLEEP (OL)
           Displey (1, Row, Col, MyThreedNum) :
 sefemend ()
      etetic long semaphore - 8 ;
                  ReturnVelue :
      int
      possemmequest ((unsigned long) (long for *) 4Somephore, -1L) ;
      ReturnVelue = rend () ;
```

Figure 2: The ALPHSOUP program creates 26 additional threads of execution and demonstrates how semanhones present library function recurrency problems.

old and half updated. Clearly, the results would be a little more random than one would prefer!

CRITICAL SECTION SOLUTION Let's fix the rand function without rewriting it. One solution is to use the DosEnterCritSec and DosExitCritSec functions 1 discussed earlier. You make up your own function called (for example) SafeRand. It looks

like this:

```
SafeRand ()
{
  int ReturnValue ;
  DOSENTERCRITSEC () ;
  ReturnValue = rand () ;
  DOSEXITCRITSEC () ;
  return ReturnValue ;
```

Now instead of calling rand in your program you call SafeRand. The two critical section functions allow only one thread to call rand at any time.

THE SEMAPHORE SOLUTION As a general solution to the reentrancy problem, the critical section functions are probably overkill. DosEnterCritSec suspends all other threads in the process. You don't need to go that far—you only need to prevent multiple threads from calling rand at the same time.

You can do this more efficiently using a semaphore.

Semaphores are likely be the topic of a future Environments column, so I only want to touch on them briefly at this point. There are two basic types of semaphores. System semaphores have filelike names and can be shared among processes. RAM semaphores are private to a process but can be shared among freeds. We'll create a RAM semaphore to solve the rand reentrancy problem.

Semaphores have two general applications: signaling and resource control. In both uses, semaphores often serve as terminary madblocks for a thread of execution. When a thread comes up against a semaphore that is "set" or "owned" by another thread for process), the thread is blocked or suspended. When the other thread for another process) "clears" the semaphore, then the blocked thread proceeds.

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■ ENVIRONMENTS

```
DOSEDNIAM (Unsigned long) (long for *) Ademaphora);

proving Returnvalue;

| Display (Cycle, Rew, Col., Rem)
| Section (Cycle, Cycle) | Cycle == 0 7 Rem * 'A' ' ' ' ';

| Section (Cycle, Cycle) | Cycle == 0 7 Rem * 'A' ' ' ' ';

| Section (Cycle, Cycle) |
| Section (Cycle, Cycle) |
| Section (Cycle, Cycle) |
| Section (Cycle, Cycle, Rew, Col., S) |
| CyclestCELLATE (String, 2, Rew, Col., S) |
| CyclestCELLATE (String, 2, Rew, Col., S) |
```

In a signaling application, the fact that the thread was able to proceed past the semaphore is, in effect, a form of interthread or interprocess communication. In a resource control application (which is

■ Semaphores have two general applications: signaling and resource control. In both uses, they often serve as temporary roadblocks for a thread of execution.

what we'll be using), an unblocked semaphore lets a thread use a particular resource, such as the rand function.

If OS/2 did not support semaphores, you might try mimicking their operation like this:

The first thread that calls SafeRand sets the Flag variable to 1. Any other thread calling SafeRand will be blocked by the while statement until the first thread sets the Flag variable to zero. But we've written some bad code here: that while statement is cating up time slices waiting for a previous thread to reset the flag. Moreover, we haven't been able to get rid of the critical

haven't been able to get rid of the critical section functions. With semaphores, you don't have to worry about such stuff. Here's the sema-

phore version of SafeRand:

```
SafaRand ()

{ tatic long Samaphore = 6;
    int Saturavajus;
    lossessocutar (unasigned long)
    costessocutar (unasigned long)
    Raturavajus = rand ()
    possessocutar (unasigned long)
    (Long far ) + Samaphore ;
    ratura Raturavajus = rand ()
    ratura Raturavajus = rand ()
    ratura Raturavajus = ratura Raturavajus = rat
```

The DosSemRequest and DosSemClear functions are two of the eight semaphore functions supported by OS/2.

The excessive casting in the DosSem-Request and DosSemClear functions is necessary because of the inadequate header files provided with the initial OS/2 Software Development Kit. The function calls should really look like this:

DOSSEMREQUEST (&Semaphore, -1); and

DOSSEMCLEAR (&Semaphore);
The Semaphore variable is initially set to zero, which means that it is "unowned." When a thread executes DosSeg-Request, the semaphore is set to an 'owned' state. Now if another thread at-

tempts to call DosSemRequest, the thread will be blocked until the semaphore becomes unowned again. During the time the thread is blocked, it doesn't use up any time slices. The thread becomes unblocked when the first thread is finished with the rand function and calls DosSem-Clear.

This SafeRand function is used in the ALPHSOUP program, shown in Figure 2. ALPHSOUP recrates 26 threads, each of which displays a letter (A through 22) on the display and moves it around randomly. The letters take little random walks around the screen or —if you prefer—resemble a bowl of alphabet soup during an earth-quake.

OTHER C PROBLEM FUNCTIONS If you'd like to ponder the difficulties of rentrant C library functions on your own, take a look at strtok. This function has to save a pointer that it uses on successive calls to the function. Think about two different threads attempting to divide two different strings into delimited "tokers" use in this function. Think about a mess.

How would such a function be written

so that it could work with multiple threads? It should be obvious that the strtok function itself has to determine which thread is calling the function and store separate static data for each thread. The strtok function can obtain the thread ID from the DosGePlé function; it would then have to allocate memory to store the static variable along with some look-up tables to match thread IDs to static data associated with each thread.

The same technique could also be adapted for rend so that the function maintained separate seeds for each thread. If two threads start with the same seed, they get the same pseudo-random sequence back from the function. Certainly that wouldn't be appropriate for the ALPHSOUP program, though it might be good for other applications.

Now that we're talking about two multiple-thread versions of the rand functions, you can begin to see why the people involved with compiler development at Microsoft start to groan when the subject of library function reentrancy comes up. It's certainly not as simple as it first seems.



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DEMYSTIFYING THE PRINTF FUNCTION



Printf is one of C's most versatile functions. Here's how to use its output formatting capabilities and how to call it from programs written in assembly language.

In the last issue, I discussed C's sonal family of powerful input conversion functions. This time, I'll introduce you to the corresponding C family of portner output formatting functions. Hard-core MASM devotes can either enviously read formatting functions. Hard-core MASM devotes can either enviously read from the call print from a MASM application, or they can wait for the next issue, in the case of the call of the call

Although it is considerably more versatile and powerful, printf is a sort of cryptic C equivalent of BASIC's PRINT USING. C gurus often put forward printf as a example of the richness and vitality of the C language, even though it is actually a library function (and a highly arppical one at that) rather than a language element.

Newcomes to C, on the other hand, are often put off by the fact that print f program statements look a bit like alphabe soup. The relatively lengthy and complicated description of print in the C runnine library manual doesn't make things easier for the novice. In reality, however, print is n'al that mysterious, and now that we have integrated development environments like Turbo C and QuickC, you can afford to experiment with print f until you learn to use in effectively.

OUTPUT FORMATTING IN C Printf, which is the prototype C function for output formatting and conversion, is used in the form The arguments for printfare the address of a "format string" and zero, one, or more variables, characters, or pointers to strings. Printfinterprets the format string on the fly, building an output string by combining the format string's contents with the other arguments, and converting binary arguments to ASCII where necessary.

sary. The resultant string is sent to the standard output device (a tolout), which is co-dimarily the viside odisplay. The string can to a file, however, by using the "or "> command line parameters. The "value" of the print f function is the number of characters that are sent to the standard output. It's only fair to note at this point that the number returned by print f is typically ignored by C programmers, so I will not be sufficiently by given the programmers, so I will not be sufficiently the programmers, so I will not be sufficiently the programmers, so I will not be sufficiently considered (states = ...)

You can perform multiple conversions

C gurus often put forward printf as an example of the richness of the C language, even though it is actually a library function. of the same or different types with a single print f function call. The content of the format string is the key to the use of print f, and it may consist of three basic elements:

- Ordinary characters other than the \ or %
- Escape sequences: special character sequences that begin with the backslash (\) character.
- Format specifications: fields that always start with a percent sign character (%) followed by other characters that indicate data types and field

The ordinary characters in the format string are simply copied by printf to the standard output as they are encountered. This allows literal text (messages that do not change) to be inserted in the output.

Escape sequences represent control or graphical characters that could not otherwise be included in the format string because they would confuse the editor and compiler. Escape sequences consist of a backslash followed by a single character or a sequence of digits. Some commonly used escape sequences are

\t signifies the "tab" character
\n signifies a "new-line" sequence (a carriagraturn followed by a line feed)
\b signifies a "backapace" character
\f signifies a "form-feed" character

To print a literal backslash character on the standard output device, you must double it; in other words, you must include the se-

quence \\

in the format string.

■ POWER PROGRAMMING

Miscellaneous other special characters can be represented with a backslash followed by their octal or hexadecimal values. For example, the Escape character (1BH) can be represented with cither \033 (octal) or \030B (hexadecimal).

When print? encounters a format specification in the format string, it attempts to insert the next argument in its parameter list into the output stream according to the format specification, converting binary to ASCII as necessary. A format specification consists of several mutually dependent subfields and takes the form

%[-][+][SPACE][#][width][.precision] [F|N][h]1|L]type

C Data Types Used

in Formatted Output

[Note that the format specification has been shown on two lines only to fit it into the column width. Note, too, that the word SPACE, above and subsequently, stands

Type of character Input expected d Decimal integer o Octal integer i Decimal integer i Decimal catal, or hexadecimal integer u Unsigned decimal

integer
e, E, 1, g, or G Floating-point value

Single character

ASCIIZ string (one or

more characters)

Pointer in the form segment:offset

Some of the data types recognized by the printf function in Microsoft C, Version 5.0; QuickC; and Turbo C. The types in this list are a superset of the types specified in the draft ANSI C standard. for a single ASCII character space, i.e., 20h or 32d.—Ed.] The type is a single character that specifies the type of argument expected and controls its conversion. The available types include characters, strings, signed or unsigned decimal, cottal and hexadecimal integers, and floating-point numbers (see the table "C Data Types Used in Formatted Output").

Types Used in Formatled Output 1.7.
The width subfield is a positive integer that controls the minimum number of characters in the formated field, the field is pudded with blanks if no the format of the field is pudded with blanks if no the format of the field is pecification, the format of the field is pecification, the format of the field in the field when the width value begins with a 0, meric types are guided with leading zeros instead of blanks to fill the field from useful relef-justified fields, obviously). If a converted value is too large to fit in a field with characters, the complete value is

always displayed. Precision controls the number of digits formatted after the decimal point for floating-point numbers. If precision is used with an integer type, it has the same general effect as width, except that the field is always padded with leading zeros and numbers will be truncated if necessary to fit within the specified number of characters.

The + and SPACE modifiers affect the formatting of signs on numeric types. If + is present, a signed number will be prefixed with a + or - character, as appropriate. If SPACE is present, the output value is prefixed with a blank if it is positive; a SPACE is overriden by a + modifier if both are present. If neither modifier is present, a - is prefixed to negative numbers, but nothing is prefixed to positive numbers.

The action of the # modifier depends on the data type. When used with an octal or hexadecimal integer, the output is prefixed with a 0, 0x, or 0X. When used with a floating-point number, it forces a decimal point to be included in the output in all cases, and (for the g or G formats) it prevents truncation of trailing zeros.

The optional F or N modifiers indicate that the corresponding pointer in the argument list refers to a "far" or "near" data object. The 1, L, or h modifiers indicate that the data object is "long" or "short."

 Although present in Microsoft C 5.0, the F and N modifiers are not part of the ANSI draft standard and should be avoided when portability is a consideration.

Although present in Microsoft C 5.0, the F and N modifiers are not part of the ANSI draft standard and should be avoided when portability is a consideration.

Under normal circumstances, you are not likely to need any of the printfmodifiers except I, which displays 32-bit decimal and bexadecimal integers, which is especially useful when debugging a program. The +, SPACE, #, F, N, L, and h modifiers are infrequently used, and you can safely ignore them for the present.

USING PRINTF The simplest use of printf is with no arguments other than the format string itself:

printf("This is a test"); This is not so different from the puts function, except that puts always adds a newline to the end of the string being outputted, whereas printf sends a newline only if you include the escape sequence \n in the format strine.

Next, let's consider the most popular application of printf: displaying the contents of a variable together with some explanatory text.

int x = -1;
printf("The value of x is %d", x);

This results in the following display: The value of x is -1

As you can see, printf simply copies all of the characters up to the % sign in the format string to the standard output. The %d format specification tells printf that the stack also contains an int binary argument for output. Print? therefore converts the next stack item to an ASCII string and displays it. The width, precision, and other modifiers are not present, so print? doesn't attempt to pad, right-justify, or limit the width of the numeric field.

Since printf knows about strings and characters in addition to binary numbers, I could have also coded the above example thus:

int x = -1; printf("%s %d", "The value of x is", x);

The output would be identical. For that matter, I could have explicitly passed the strings as pointers, like this:

From this last example, you can begin to appreciate the run circumses of printf, part of which lies in the fact that the format string need not be completely determined at compile-time. The application program can use C's string functions (such as streat, strspn, and strst;) to build up a format string at runtime. This allows you to deal with data whose range, size, and type can't be predicted in advance.

Figure 1 contains a slightly more complicated example in the form of a little program named FPDEMO. C. Here, prant is is used to form as pretty table of flowingpoint numbers. Type in the program, complie it, and run it, and then compare the output with the format strings used in the various calls to printf. Once you have puzzled out the correspondence between view, you will be well on your way to putting, printf 10 work in your own programs.

The printf function also has a number of cousins that are useful in special situations (see the table "Printf and Related Functions"). These related functions work in the same general way, save that they accept arguments from an array or send their output to a file or as an ASCIIZ string. Once you've mastered the basic printf, you'll have no problem with its more-soohisticated relatives.

There are many subtle points associated

with printf forms specifications that I have not touched on in this brief overview. Most C motime library manuals devote the control of the control of the control your time to read the printf entry carput lime to read the printf entry carluly. Printf has been honed and refined through many years of use to meet almost every conceivable formatting need; you can realize its full potential only with study and practice.

DEBUGGING PRINTE CALLS You may have noticed that it is only by decoding the format string that print! Knows how many arguments it has (or should have) been passed. In this respect, print! (like sean!?) is an abertation in the otherwise orderly world of the Cruntime library, whose functions typically require a fixed number of arguments.

Printfalso has no way to tell whether

the arguments that follow the format string are the appropriate types for the corresponding format specifications. It simply does the best it can with the things it finds on the stack. This can lead to some unplessantly interesting results. If, for example, print! thinks a floating-point number is a string for vice versa), you will probably see little blinking happy faces and other novelties on your screen where If print f thinks a floating-point number is a string, you will see happy faces on your screen

where you were expecting to see something a little more intelligible.

you were expecting to see something a little more intelligible.

The print f function's ability to han-

die variable numbers and types of arguments has an unfortunate coordiary: the C compiler rarely gives you any help with print f problems. Since the format string is either a literal or a pointer, the compiler doesn't look at it, it simply assumes that you know what you are doing. If you pass print ft doe few or the wrong types of arguments for the form of the compiler performs is job without comment, but the

Printf and Related Functions

Function	Definition
printf	Accepts a pointer to a format string and zero, one, or more binary values, characters, or pointers to strings. Formats an output string and sends it to the standard output device (stdout).
fprintf	Like printf, but sends the output to the specified file or device.
sprintf	Like printf, but places the output string in the specified character array.
vprintf	Like printf, but accepts a pointer to a list or array of arguments rather than the arguments themselves.
vfprintf	Like <code>vprintf</code> , but sends its output to the specified file or device.
vsprintf	Like vprintf, but places the output string in a character array.

Any of these similar functions can be used to output formatted strings in C.

■ POWER PROGRAMMING

output of your program will then be incorrect. Fortunately, printf problems are usually easy to diagnose and fix. Mismatching of data types will lead to glaring-

ly obvious gibberish in your program's output. And, unlike scanf, printf doesn't alter the values of variables, so it doesn't ordinarily cause program crashes when you use it incorrectly.

```
fpdemo.c --- demonstrates use of printf to format
pretty tables of floating point numbers
         PC Magazine - Ray Duncan
./
#include <stdio.h>
#include <stdlib.h>
main(int argc, char *argv[])
   int i,j;
                                               /* some integer variables */
                                               /* floating point variable */
   printf("\n\nprintf floating point demo\n\n\t");
   for(i=1: i<11: i++)
                                               /* print column numbers */
      printf("$7d", i);
   for(i=1; i<21; i++)
      printf("\n%2d\t", i);
for(j=1; j<11; j++)
                                               /* print row numbers */
        f=(double) j / (double) i;
printf("%7.3f", f);
                                               /* type cast and divide */
                                               /* display results */
  3
```

Figure 1: A short C program that demonstrates some of the formatting power of the printf

CALLING PRINTF IN MASM If you own a C compiler, have a desperate need for printf's capabilities in a MASM application, and have no inclination to write your own equivalent routine, you can always take the easy way out and simply link printf right into your program. This isn't terribly memory-efficient, since printf will cascade all sorts of supporting functions into your program from the C

runtime library, but sometimes it can be a big timesaver. Figure 2 contains another little demonstration program, CALLPRTF, ASM, which illustrates a MASM call to printf to format and display both a string and a 16-bit integer. Note that printf's parameters are pushed onto the stack from right to left (in terms of the way the call would be written as a C program statement). In other words, the last argument is pushed first, the next-to-last argument is pushed second, and so on, and the address of the format string is pushed last. Also, the name of the external printf function must be prefixed by an underscore character (_) (the C compiler also does this, but it is invisible to the programmer).

The declaration of the external symbol _acrtused forces the C startup code.



Floure 2: This assembler program shows the techniques needed to access the C function printf in assembly code.

Fortunately, printf problems are usually easy to diagnose and fix. Mismatching of data types

will lead to glaringly obvious gibberish in your program's output.

which initially receives control from MS-DOS, to be linked into the program. This is a "magic" name and may differ from compiler to compiler (or even from version to version of the same compiler). The startup code sets up the stack and DS register and then transfers control to our MASM routine _main, which is declared public so that it is visible to the Linker.

To assemble CALLPRTF ASM into the file CALLPRTF.OBJ. use

MASH /Mx CALLPRTF;

The /Mx switch causes case distinctions to be preserved in public and external names (since C is case-sensitive). Then, to link CALLPRTF.OBJ with the Microsoft C 5.0 runtime libraries to create the executable file CALLPRTF.EXE, you enter

LINK CALLPRTF ... SLIBC+LIBH:

If you are using Turbo C or an earlier version of Microsoft C, the LINK command may be somewhat different, but the general procedure should be the same. If your MASM program performs floating-point operations or formats floating-point numbers for output, you must also specify the appropriate floating-point libraries in the LINK command.

THE IN-BOX Comments and suggestions about this column from PC readers are welcome! You can contact me by the following e-mail routes:

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SPREADSHEET **CLINIC**



Avoiding @AVG miscalculations; automatically sizing columns to match their label requirements; adding missing edit functions; better ways to stop autoexec macro execution.

WIDENING 1-2-3 COLUMNS

I often need to widen a column just enough to allow the longest label in that column to be displayed in full form. After getting tired of doing this manually. I developed the macro shown in Figure 1. Now, whenever I need to widen a column to accommodate its widest label. I simply invoke the macro and highlight the cells on which I want to base the column width. In a few seconds. 1-2-3 expands (or contracts) the width of the column so that it is as wide as the cells I have highlighted. Feline Ouental

Rio de Inneiro Brazil

Mr. Quental's macro is both elegant and useful, so it may be worth detailing the steps in its operation. The first statement in his macro lets you highlight the cells to establish the column width and assigns the name RANGE to that range. The second statement freezes the screen for the remainder of the execution of the macro, and the third statement moves the cell pointer to the topmost cell of the single-column range you've specified. The fourth statement places the value 0 in the cell named LENGTH1 (cell B16).

The fifth statement in this macro tells 1-2-3 to execute the subroutine named MEASURE (cells B10..B13) as many times as there are rows in the specified range. The first statement in MEASURE tests to see if the entry in the current cell (originally, the topmast cell in the range you specified) contains a label. If not, it mayes the cell pointer down one cell and begins another pass through the loop. If | column to be displayed in full form.

the cell does contain a label, the macro continues with the subroutine, executing

the statements in cells B11. B13. The statement in cell B11 instructs 1-2-3 to recalculate the string formula in the cell named NEXT-the next cell in the

+"{Let LENGTH2.@LENGTH("

macro. The formula

&@CELLPOINTER("address")&"))" returns a {Let} statement that commands 1-2-3 to place the length of the entry in the current cell into the cell named LENGTH2 (B17). The final statement in the subroutine commands 1-2-3 to place into LENGTHI (cell B16) the value in LENGTH1 (the length of the entry in the previous cell) or the value in LENGTH2

(the length of the entry in the current cell). whichever is greater.

1-2-3 continues in this fashion to make one pass through the loop for each cell in the range you specified. After the final pass, LENGTH1 will contain the length of the longest label in the range. At that point, 1-2-3 will return to the main part of the macro and execute the statements in cells B6..B8. The statement in cell B6 places the string equivalent of the value in LENGTH1 (the length of the longest label in the range) into the cell named STRING (R18) The statement in cell R7 then sets the width of the column to that length, after

which the final statement in the macro un-

freezes the screen @AVG TRAP

I recently discovered a property of the @AVG function of which other 1-2-3 users should be aware. When 1-2-3 calcu-

```
/rncRANGE?(?)"
                   (WindowsOff) (Paneloff)
                   (Goto) RANGE
                    (Let LENGTH1,0)
                   (For COUNTER, 1, GROWS (RANGE), 1, MEASURE)
                   (Let STRING, @STRING(LENGTN1, 0))
                    /wos(STRING)
                    (WindowsOn) (PanelOn)
MEASURE (If @CELLPOINTER("type")<>"1") {Down} {Return}
NEXT
              +"(Let LENGTH2.@LENGTH("#@CELLPOINTER("sddress") 4
                   (Lot LENGTH1, GMAX(LENGTH1, LENGTH2)) (Down)
COUNTER
LENGTH1
LENGTH2
STRING
```

Figure 1: This macro widens or tightens a column just enough to allow the longest label in that

■ SPREADSHEET CLINIC

- Instead of using an
- @AVG function, use an @DAVG function that
- references a criterion.

lates an @AVG function, it computes the sum of the values in the range you specify, counts the number of entries in that range, and divides the sum by the count.

Unfortunately, 1-2-3 doesn't count just the values in the range—it counts the labels as well. Consequently, if the range on which the @AVG function is operating contains labels as well as values, the count will be erroneously high, and the average will be too low.

To demonstrate this effect, 1'll use the worksheet shown in Figure 2. Cells A2. A6 contain values, and cell A7 contains the label '...... Given these entries, the function @AVG/A2. A69 would be return the values (300, the result of dividing the sum of these values (1,500) by the number of entries in the range (5). But the function @AVG/A2. A7), which references the label in cell A7 in addition to the concess the label in cell A7 in addition to the 250, the result of dividing the sum (still 1.500) by the new (still 1.500).

Fortunately, there is a way around this problem. Instead of using an @AVG function to calculate the average, use an @DAVG function that references a criterion range containing the criterion

@CELL("type",XX)="v"

where XX is the address of the first cell of the range you want to average. For exam-

	A	В
1	Amount	
2	100	
3	289	
4	300	
5	468	
6	544	
7		

Figure 2: Cell A8 in this worksheet contains the function (aAVG(A2..A7).

ple, to calculate the correct average of the entries in cells A1...A7 of the worksheet shown in Figure 2, you would cropy the label ¹Amount from cell A1 into another cell (say, cell C1). Then, using A2 for XX, you would enter the criterion function into the cell immediately below—in this case, cell C2. After setting up this criterion range, you could use the function

@DAVG(A1..A7,8,C1..C2)

to calculate the average. Since the criterion commands 1-2-3 to work only with cells that contain values, this function returns the value 300—the correct average.

Brent R. Avera

Fort Myers, Florida

This is a clever solution to a long-standing problem with 1-23. For the method to work, of course, there must be a label the top of the column whose values you are averaging to serve as its field name.

STOPPING AUTOEXEC MACROS

The December 8, 1987, Spreadsheet Clinics showed a number of ways to keep an autoexec macro from executing when you retrieve the worksheet that contains it. But it did not mention the technique that I have found most useful. At the beginning of my auto-executing macros, I use the routine shown in Figure 3.

The first statement in this routine types the prompt message on the Edit line, but does not lock it into the worksheet. If you hit a key during the pause, 1-2-3 will store it in its keyboard buffer. The prompt is

Remainder of macro....

then cleared, and the fourth statement in the macro tells 1-2-3 to look to the keyboard buffer. If you typed a character during the pause, 1-2-3 will place a representation of that character into a cell named KEY, which you should include near the end of your macro. If you didn't type anything, 1-2-3 will enter a null label.

ines the contents of KEY. If KEY contains and Il abel, 1-2-3 will execute the remainder of the macro, which should immediately follow this macro-canceling routes If KEY contains a label other than a null label (indicating that you pressed a key durning the pause), 1-2-3 will remove the key from the keyboard buffer and cancel the execution of the macro.

The fifth statement in the macro exam-

You can shorten or lengthen the duration of the pause simply by changing the argument of the {Wait} statement. If you do, just alter the prompt to match. Mark Crane

Louisville, Kentucky

Mr. Crane's technique is a classic use of 1-2-3's {Look} command. A {Look} command is perfect here because it allows the macro to continue unless you specify otherwise, rather than not executing unless you instruct it to do so.

The only problem with this macro is that it doesn't cancel the macro as soon as the user presses a key. Instead, it waits until the end of the pause to check the key-board buffer. The revised routine shown in Figure 4 takes care of this minor annoyance by locating the [Look] command

```
\8 To cancel this macro, press any key within 5 seconds...

{\text{Mail @Most+@TIME($,6,5)}}
{\text{Esc}}
{\text{(Look RET)} {\text{Get} \text{RET} {\text{(Quit}}}
```

Figure 3: This routine gives you 5 seconds to prevent the execution of an auto-executing macro.

```
\8 [As THAT, Smos)

To constitute managers, press any key within 5 seconds...

LOOF (LOOK KEY) (Set KEY) (Res)(Oult)

(If Exposed-managers)(4,5))(at anothology)

Head loter of marchy.
```

Figure 4: This revision of the routine shown in Figure 3 stops the execution of the mocro as soon
as you press a key.

A	1 6
\a	(Edit)(?)"
LOOP	(GetNumber "Enter edit type [1-3]: ",TYPE)
	(If TYPE<1#OR#TYPE>3)(Beep)(Branch Loop)
	(Left)
	(Let HERE, @INDEX(TABLE, B, TYPE))
RERE	
	/rv^(Right)~
	/re"
TYPE	
TABLE	'GLEPT((Right), @FINO("*", (Right), #))"
	'GRIGHT((Right), GLEMSTE((Right))-GFIND(""", (Right), 8;-1)" 'GLEFT((Right), GFIND(""", (Right), 8;))
	LORIGHT((Right), GLENGTH((Right))-GTIND("+", (Right), 8)-1)"

Figure 5: This macro adds block-editing features. Cell B14 is shown broken into two lines.

within a loop. Consequently, 1-2-3 executes it many times and will cancel the execution as soon as you press a key.

AN EDITING MACRO

The macro shown in Figure 5 adds three editing features not normally available in 1-2-3. First, it can delete the characters to the right of the point you specify within an entry. Second, it can delete the characters to the left of that point. Finally, it can remove the characters between any two points you specify.

Before invoking the macro, you should position the cell that contains the label you want to cell that contains the label you want to cell. The first statement in the macro brings that label to the Edit line and pauses for you to insert the appropriate block marker symbols. To delete characters from a certain point to the beginning or end of the label, marker at that point. To remove a block of text from a the the middle of the label, insert an "a the beginning or the block and a " (plus) at the end.

When you have inserted the appropriate marker(s) and pressed Entire, you're prompted for the number that corresponds to the type of eld you want to perform. Entering 1 will delete all the characters to the right of the "marker, 2 knocks out the characters to the left of the cursor; and 3 chops out the portion of the label between the "and + markers. Just press Enter after typing the appropriate value.

The fourth statement in the macro inc. We' moves the cell pointer one cell to the left. This cell should be blank. The next statement places the label form of the formula picease corresponding to your choice of editing type from the three-cell range named IN-DEX in this case, cells B12. B14 jut not he

cell named HERE (the next cell of the macro). When I-2-3 executes the cell named HERE, it enters the label form of the formula in that cell into the cell where the pointer is positioned. (This will be the cell to the left of the one you are editing.) The formula returns the desired substrine

This editing macro demonstrates a clever

use of 1-2-3's string functions and @INDEX.

and the macro continues by copying that over the original label. The final statement in the macro crases the formula.

> Richard Ruiz Toronto, Ontario Canada

Mr. Ruiz's macro demonstrates a clever use of 1-2-3's string functions and its @INDEX function. In most cases, however, it would be easier to use the Backspace and Del keys to edit labels.

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User-to-user



Cutting away spaghetti code from batch files; outputting numbers and control characters from the command line; and an easy way to switch subdirectories and save keystrokes.

CREATING SMALL FILES

Did you ever want to send just a few control characters to your printer? Or create a small file to use as input to another program? And did you ever want to do these things from within a hatch file, without op erator intervention? Most text editor won't handle control characters. Some car he coaxed into running themselves (through the use of macros), but using them to create a file a few bytes long is like using a pile driver to pound in a carpe tack-effective, but excessively time-con suming when setup time is considered. Us ing BASIC or DEBUG is not much better.

The small ONCL.COM program created by the ONCL.ASM listing in Figure or the ONCL.BAS program in Figure : does all these things very well. Just type ONCL followed by the decimal values fo the desired characters. The utility sends the characters to the standard output, from which they can be redirected to a file, ar output device, or another program.

For example, to configure my printer to its elite pitch, I can type

ONCL 27 77 27 126 1 >PR Then to get it back to its default configuration, I can type

ONCL 27 126 0 27 80 >PR

The utility can also be used to make small files containing control characters. If the characters won't fit on the command line. the utility can be called repeatedly, using the double hracket to append the output to the previous results. For example, Figure 3 shows the utility making a copy of itself. If Figure 1: ONCL ASM source code. Assemble, Link, then EXE2BIN it to produce ONCL.COM.

; Output numbers ; by Philip J. E		ind line	
C00E	STORTST		
	ASSUNZ	CS:C00E	
	ons	1002	
KAIN	790C	NEAR	
	CLD	SI,81H	; pointer to command line ; clear direction fleq
MAIN_LOOP:	LODGE		get next character
	CME	AL. 13	: cerriece ret enda command lin
	22	MAIN EXIT) cerriede Let euge command III
	CALL	IS DIGIT	: is the character e digit?
	30	MAIN LOOP	: if not, keep acanning
	MOV	PL.AL	: if so, DL = numeric velue
NUMBER_LOOP:	LODES	,~-	; get next cherecter
system_poor.	CALL	IS DIGIT	: is the character a digit?
	ac .	OUTPUT	; if not, go output byte in DL
	A00	DE.DE	; otherwise DL = 18 * DL + AL
	ADD	AL.DL	,
	A20	DL.DL	
	ADD	DL.DL	
	ADD	DL. AL	
	2002	NUMBER LOOP	; continue scenning number
OUTPUT:	FUSH	DX	; push byte to steck
	MOV	8X, 1	; stenderd output hendle
	807	DX.57	: one-byte huffer is on stack
	HOV	CX, 1	; cherecter count is one
	MOV	AH, 4FH	; pos file output
	297	218	
	POP	DE	; restore steck
	DEC	SI	; decrement pointer
	JHP	MAIN LOOP	; keep going
MAIN_EXIT:	RET		
KADI	ENDP		
goonvert en ASC	II diqit (4	8-57) into the co	rresponding numeric value
; (8-9), end ret ; not e digit	urn with th	e cerry fleg set	if the ASCII character is
IS_DIGIT	PROC	REAR.	
-	503	AL, '8'	; convert to numeric velue
	эc	IS DIGIT EXIT	; carry set if cher < '0'
	MOV	AX,9	
	CHP	AH, AL	; carry set if number > 9
IS DIGIT EXIT:	RET		
2000	ENDS		

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■ USER-TO-USER

188 * ONCL. BAS PROGREE TO CREATE ORCH. CON - Philip J. Erdolsky 1128 E-113CE (1971)** "Checking DATA" please vail..."
128 FOR BH-1 TO 4-FOR C-1 TO 16:FEEDA 54:TO-T-VAL(*CH**+45):HEXT 128 FOR BH-1 TO 4-FOR THE FEEDA ** THENNIE IN LINE print(*PHIRED**) THE FEEDA ** THE PRINT IN LINE print(*PHIRED**) THE PRINT IN LINE PRINT

Flower 9: PASIC ONCL PAS assessment a secret ONCL COM

ure 2: BASIC ONCL.BAS program to create ONCL.COM.														
DNCL	198	1	29	g	25	52	17	12	68	13	116	42	>ONCL2.COM	
ONCL	232	4	3	ø	114		45	5 1	38	298	17	2 :	>>ONCL2.COM	
DNCL	232	3	2	8	114	4 1	2	2	21	Ø 2	194	2	>>ONCL2.COM	
DNCL	219	2	2	16	2	26	18	23	15	238	82	187	>>ONCL2.COM	
DNCL	1 9	1	39	2	12	18	35	1	9	189	64	285	>>ONCL2.COM	
DNCL	33	90	7	8	235	5 2	98	3 1	95	44	48	114	>>ONCL2.COM	
ONCL	4 1	88	9	5	8 2	224	1 1	95	,	>>ON	CL2	.co	H	

Figure 3: ONCL.COM can make a copy of itself using these lines of code.

you don't redirect the output, it will go to the screen. For example, the command line

ONCL 7

will make the console beep. You might want to put this at the end of a long batch file so the computer will call you when it's done.

Power users may wonder why I used DOS function 40 to output a single byte, when it would have been much simpler to do it with DOS function 02 (which sends the contents of DL to standard output). The reason is that DOS function 02 does some meddlesome things like expanding tabs. Philip J. Erdelsky

This is also useful for generating ANSI Escape sequences. If you have ANSI loaded with a DEVICE=ANSI SYS line in your CONFIG.SYS file), you can run com-

San Diego, California

ONCL 27 91 51 55 59 52 52 109 to set the colors to blue text on a white

ONCL 27 91 51 52 59 52 55 189

background, or

ground, or

ONCL 27 91 74
to clear the screen to those colors. This

works because
ONCL 27 91 51 55 59 52 52 189
| | | | | | | | | | | |
ESC [3 7 ; 4 4 m
character

and the command to set colors to white on blue is ESC (the ASCII 27 Escape character) plus [37;44m. This can also come in handy when

you're trying to create a COM file and all you have is a list of DATA statements in a BASIC program. If the list is made up of text numbers, you can use the DEBUG E command to enter them directly. But if the numbers in the DATA sustements are detimal, ryy adapting the technique bir. Edelsky used to create the ONCL. COM program itself.

BATCH BRANCHING SHORTCUTS

Much has been written about ways to get around DOS's inability to treat direct calls to batch programs the same way it handles other executable commands from within batch files—as subroutines. By now most users are familiar with the way to call an-

■ USER-TO-USER

other batch file by first loading a secondary command processor (with COMMAND /C) to run the second batch file and then return to the first. DOS 3.3 has made things even easier by adding a CALL command to turn batch branches into subroutines.

However, calls to executable programs and system commands always act as sub-

Branching can be time-

consuming and confusing to edit. Capitalize

on DOS's absolute branching feature.

routine calls, returning processing to the next line in the batch file. Many times it's necessary for a batch file to branch to one other command after an IF test and then exit. This is usually done with a cumbersome and clutter-producing GOTO command that branches to another part of the batch program, runs the desired com-

mand, and then branches again to a com-

mon exit point, such as a final line called

END. All this branching, especially in long batch programs, can be time-consuming and confusing to edit. A quick alternative is to capitalize on DOS's absolute branching feature by calling a batch file that simply runs a program or an internal DOS command and then quits. The DO.BAT batch file that can accomplish this for you consists of just one line:

@%1 %2 %3 %4

(The initial @ will prevent the line from displaying and works only in Version 3.3 or later. Omit it if you're using an older version of DOS.)

This is a very fast approach, especially when a RAM drive is used. Typically, an IF test (or ERRORLEVEL check after an input-capturing routine such as GETKEY. COM) branches to an executable DOS command or .COM or .EXE program and then quits.

Here's a very simple example of DO displayed:

.BAT used in a program called #.BAT, which displays either a selected phone number or your entire phone list, depending on whether you specify a parameter when you run it. So

Nixon

.

or # (212)

would find all listings with Nixon or (212) in them, while

by itself would display the entire list. The

by itself would display the entire list.

Batch file looks like

OECHO OFF

REH #.BAT

IF %1:==1 DO BROW

IF %1:==! DO BROWSE C:\OATA\PHONE.DAT FIHD "%1" C:\DATA\PHONE.DAT

It uses Charles Petzold's PC Magazine utility BROWSE. The usefulness of DO. BAT can be seen when you consider how it might clean up multiple GOTO branching in a long, involved batch file, not to mention always being available as a command for all other batch files in your system. Without the use of DO.BAT, the original batch file would have been written like this:

GECHO OFF REM #.BAT

IF "%1"=="" GOTO SEELIST FIND "%1" C:\DATA\PHONE.DAT GOTO END :SEELIST

BROWSE C:\DATA\PHONE.DAT

I also keep two other speedy RAMdiskready batch files handy—ABORT.BAT and COMPLETE.BAT—that can branch absolutely. These will quickly quit any batch file after an IF check, with the option of including a message:

REW ABORT.BAT IF NOT \$11==1 ECHO \$1 \$2 \$3 \$6 \$5 \$6 \$7 \$8 \$9 ECHO Operation aborted.

REM COMPLETE.BAT
IF NOT \$1:--: ECHO \$1 \$2 \$3 \$4 \$5 \$6 \$7 \$6 \$9
ECHO Operation completed.

These will let you have a line like this in your program:

IF NOT EXIST ASC ABORT ASC not found.

If ABC is not found, the batch file will quit without any GOTOs and these lines will be

ABC not found. Operation aborted.

If the words after ABORT had been omitted, then the only closing message would be "Operation aborted."

John A. Hamlin Portland, Oregon

You can combine the two techniques into one big #.BAT batch file:

REN F.BAT

IF NOT EXIST ABC ABORT ABC not found.

IF %1:--! DO BROWSE C:\OATA\PHONE.OAT

FIND "%1" C:\DATA\PHONE.OAT

In this case, whether or not you type anything after the #, the program simply won' i proceed if ABC isn' ton your dist. If you create a dummy ABC file (which contains just the word REM), the program will bypass this test and look up numbers with aplomb. If you erase the ABC file, all you'll get is an

ABC not found. Operation aborted.

message and the #.BAT file will grind to a halt.

Incidentally, these examples assume that you have a list of your phone numbers called PHONE.DAT in your C:\DATA directory and that this file is in a form (each

 The usefulness of DO.BAT can be seen when you consider how it might clean up multiple GOTO

branching in a long, involved batch file.

entry on one line with a carriage return at the end of it) that FIND can handle.

HEADING HOME

Here's an addition I made to a batch file called HOME.BAT from an earlier Userto-User (December 9, 1986). If you speci-



fy a path after the word HOME, it will set the environment variable HOMEDIR to the path and change to that directory for

ECHO OFF IF %11==: GOTO CHANGE SET HOMEDIR=%1

SET HOMEDIR=%1 :CHANGE IF NOT %HOMEDIR%:==: CD %HOMEDIR%

Joseph Gagliardo, Jr. Dumfries, Virginia

Having a batch file automatically store a path in the environment and then read it back later makes good sense. Even better,

 Having a batch file automatically store a path in the environment and read it back later makes it easy to either return to the preset subdirectory or switch into a new one.

this simple batch file makes it easy to either return to the preset subdirectory or switch into a new one. If you first type

HOME \DOS

and you later switch to another directory,

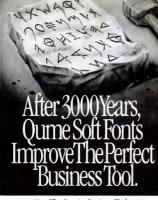
you can then type

HOME

by itself to switch you back to \DOS. However, for this to work, you have to make sure HOME.BAT is located in a directory that your PATH command knows about.

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Qume

77.

Power user

Displaying leading zeros in dBASE; formatting files in Hebrew; turning off with SuperKey; searching for strings across dBASE files; editing footnotes in WordPerfect.

HANDLING LEADING ZEROS

I recently had to create a field to hold serial numbers that had to be six characters wide, right-justified, and padded with leading zeros. The keypunchers had thousands of these to input and wanted to enter only the live digits. For example, they wanted to enter 1346 and automatically get 001346, or to key in 7A and output 00007A. The solution:

x=REPL("0",6-LEN(x))+x

Alternatively, the whole database could be entered flush left and REPI aced at one fell

REFL ALL <Fieldname> WITE;
REFLICATE("0",6-LEH(TRIM(<Fieldname>)));
+TRIM(<Fieldname>)

swoop with

Mark Albrecht Erie, Pennsylvania

I'd like to share a quick algorithm for displaying a numeric value with leading zeros. To display a six-digit integer with leading zeros, for instance, use

? SUBS(STR(188888+number, 7), 2) Notice that 1000000 will now have the six leading zeros and that starting the SUBStr operation at offset 2 will return leading zeros without the 1.

Alan Queen Boise, Idaho

dBASE III does support leading "\$" or "*" with its PICTure templates for leftfilling numbers, but not for leading zeros. This technique is also useful if you need to display leading zeros in a dBASE report form or to export an ASCII file to a mainframe that demands leading zeros.

If your need is just the opposite—you've imported a file with leading zeros and need them stripped—see "Zero Zapper" in Power User, PC Magazine, February 24, 1987.—Brad Stark

LEFT: RIGHT:

There are several font programs available that can print the Hebrew alphabet. However, since Hebrew reads from right to left, creating text files for these programs is a problem. A macro program like SuperKey can provide for normal (i.e., right-to-left) Hebrew text input.

First, define the Alt version of each alphabet key to be that key plus one Left Cursor movement. Similarly, define the Ctrl-key combination as the shifted version of the key plus one Left Cursor movement. Next, use your regular word proces-

■ Since Hebrew reads from right to left, creating text files is a problem. A macro program like SuperKey can provide for right-to-left text input. sor, in insert mode, typing as usual. The letters will fall into place one behind the other. Be sure to put a carriage return at the end of each line so words won't wrap in-

end of each line so words won't wrap incorrectly.

Keep in mind that you can also take advantage of the key-redefinition to alter the keyboard layout for easier mnemonic translation from one alphabet to the other.

Sam Weiss Baltimore, Maryland

While this is a nice trick, a number of word processing programs already use the All-key or Cirl-key combinations for commands. Using SuperKey, however, our redgine each letter as itself play a Left Arrow key by adding a Backspaote (Reves Accent.) Hoptor Epping the key. The Backspane tells SuperKey to skip the definition and type the original version of the keystroke. In other words, if you define "o" as

`a<left arrow>

then typing the a key will produce an "c", by has a Left Arrow. Superkey will also let you redefine the shifted keys differently from the unshifted keys. And you can use the same Backquote trick to redefine the Arrow. Faully, you might like to define the Einer (Carriage Return) key so jumps of the content a Ke-turn. This will make it for exsert on other a ke-turn. This will make it for exsert on other a return after each thee—M. David Store return after each thee—M. David Store processing program that handles it composessing program that handles it com-

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■ POWER USER

pletely. The Special Language Supplement to Nota Bene (Dragonfly Software, 285 W. Broadway, #500, New York, NY 10013) allows you to work, with proper character flow and fonts in English, Greek, Hebrew, Russian, et al.—Ed.1

FIND IT WITH XREF

XREF.BAT is a useful cross-reference utility for groups of dBASE programs or any other files written in ASCII format. It finds variables, reserved verbs, or constants, and you can direct its output to screen, printer, or a disk file.

The syntax requires three parameters:
(1) the filename(s) to be searched (DOS
wildcards are OK); (2) the string you are
searching for; and (3) the output device
(you type con for console or pm for print-

er, or specify a filename). For example: xref db*.prg varblname con XREF.BAT is so short you can create it

right from the keyboard:

copy con; xref.bat
ECRO OFF
FOR bab IN (\$1) DO FIND/N "\$2" \$8A >> \$3

[The 'Z can be created either by hitting F6 or by typing Cirl-Z.—Ed.] One of the nice features of this command is that it displays the line number where the target string is found, so you know where it is if you must change it. Note that the DOS program, FIND.EXE, must be in the same directory or have a path pointing to it.

Dwight Martin and Ron Trussel Minnetonka, Minnesota

Don't you just love a great one-liner? Unlike Norton's TextSearch, XREF is case sensitive, which is sometimes an analy. I prefer it to LOCATE.COM (Programming, PC Magaine, May 14, 1985) because its searches groups of files and displays the line number (and surrounding text). The big limitation of XREF is that the search string must be one word long.—Brad Statu.

TURN IT OFF

Most people use macro programs like SuperKey to minimize typing and effectively add features to their programs. Rarely discussed is the possibility of using SuperKey to turn off features. For example, the infamous Ctrl-Y command in WordStar, for "Delete a line," is far too easy to this when you mean to type Ctrl-T for "Delete a word." With Super-Key you can redefine Ctrl-Y as a harmless key combination such as Installation. You can then redefine some other key, Alt-Y perhaps, as the original Ctrl-Y with the definition

`<ctrlY>

That's Backquote (Reverse Accent) — Ctrl-Y, or <SKIP><Ctrl Y> as Super-Key will record it. This combination makes it far less likely that you will delete a line accidentally, yet it will still let you delete a line when needed at the cost of only one extra keystroke.

Daniel A. Gulkis Clearwater, Florida

Keep in mind that even if you don't set up another key to do he job, you can still use the feature you've defined away by typing the backquote first. In this example, the need to press two keys to delete a line it cumbersome. However, consider the Meme key in Coules 1-23 or SuperCale 4. The Home key in Coules 1-23 or SuperCale 4. The Home key in Coules 1-23 or SuperCale 4. The state where you are in the spreadsheet. I find it far too casty to hit that key accidentally when Invent to this the Up

■ The infamous Ctrl-Y command in WordStar is far too easy to hit when you mean Ctrl-T.

Arrow key instead. By redefining the Home key as < Ins> < Ins> , you can avoid going to AI when you don't want to but can get there easily enough by typing Backquote-Home.—M. David Stone

SEEING FOOTNOTES

Writing and editing documents that contain footnotes or endnotes (such as articles for legal periodicals) is difficult using WordPerfect. While Version 4.2's preview function lets you see the text of your

SEENOTES . MAC <Ctrl-F18>

SEENOTES<CR> <Home><Home><Up> cohift-Ply <Alt-F5>6131<CR> <Alt-F5>1 <Shift-F3> <alt_pig>pnpypc<cp>

<Ctrl-F10> FNEXEC.MAC cct+1-218> <Ctrl-F7>2<CR> <Alt-F4>

<Home><Home><Down> <Ctrl-F4>2 <shift-F3> <CR><CR><Space>

<ctrl-F4>5 <Home><Home><Down> <shift-F3> <alt=F16>FNEXEC<CR> <Ctrl-F18>

Begin macro definition Call it SEENOTES Go to top of document Switch to other document

Set paragraph numbers to legal style Turn outline mode on Back to starting document Invoke macro FNEXEC End macro definition

Begin macro definition Edit next footnote Block On To bottom of note Copy block Exit from footnote

Switch documents Separate this entry from last Retrieve text Go to bottom switch documents

Re-invoke FNEXEC End macro definition Figure 1: Two macros that allow you to write and edit footnotes in WordPerfect.

notes as they will appear after printing. you can't edit on the preview screen. In addition, preview has trouble with large documents on a dual-floopy system. [Word-Perfect creates the preview in a disk file, so you need available disk space when you preview a document.-N.J.R.] The note edit screen displays only one note at a

My solution is a macro set that displays all notes at once in Doc 2. After I retrieve the document as Doc 1. Linvoke the macro SEENOTES. SEENOTES sets up Doc 2 and chains to the macro FNEXEC, which is itself a repeating chain. When the macro finishes, simply switch to Doc 2 to view all of your notes. You can now edit a note in its proper context, cutting and pasting to Doc I's note edit screen to register changes. The two macros you need are shown in Figure 1.

Josh Divack Decatur, Georgia

This macro system creates a second document for you consisting of your endnotes alone, in order and numbered. You can print this document, save it, edit it, whatever you please. Do realize, however, that the changes you make do not affect the

original document unless you cut them from Doc 2 and paste them back in. The main benefit you get is the ability to swap

This macro system

creates a second document consisting of your

endnotes alone.

quickly between the document containing all your notes and the context of the original document.-Neil J. Rubenking

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■ EDITED BY ROBERT L. HUMMEL

LANGUAGES



Speeding up Turbo Pascal calculations; finding the total bytes for a subdirectory in C; rotating prompt from BASIC; keeping FOR loops from turning into endless loops.

BASIC

SCROLLING MESSAGES

Much of the time spent in a BASIC program involves getting a single key response from the operator in answer to a prompt. But while INPUT is a simple solution, there are much better techniques available

I have written a subroutine (Figure 1) that will display a message on line 250 fth video display, centered, and will rotate the reassage in "billiomod" fashion. The routine also accepts an attribute byte, so different nessages are the displayed in different codors. The message will rotate until a key is typed. This key is then returned to the calling program. The demonstration between the contraction of the listing films 10 through 270, prompt for changing the screen colors. A slight delay (DLV9) is provided a slight delay (DLV9) is provided to suit.

The program at fine 40111 and may be adjusted to suit.

Hubert C. Borrmann Lillian, Alabama

This is strictly for use with the BASIC Interpreter, thought is could be modified to work with QuickBASIC and Turbo Basic by changing the DATA statements as to note that the assembler roatine is really only printing the characters, and the strip rogram fragment in Figure 2 duplicates Mr. Borrman's roatine and will work with any of the newer BASIC Compilers.
—Ethan Winer
—Ethan Winer

```
20 'Line - in - Notion
38 'Demonstration of the subroutine "MOTION.SUB"
50 SCREEN 0 : KEY OFF : COLOR 7.0 : CLS : FCOL9 = 14 : BCOL9 = 8
68 ON KEY(1) GOSUB 228 : ON KEY(2) GOSUB 248 : KEY(1) ON : KEY(2) ON
78 ON KEY(3) GOSUB 268 : KEY(3) ON
75 QU$=" Line = in = Notion"
80 LOCATE 4.12 : PRINT " <F1> changes the foreground color = ":
98 LOCATE 6,12 : PRINT " <F2> changes the background color = ";
100 LOCATE 8,12 : PRINT " <F3> to quit this demonstration.";
110 LOCATE 14,12 : PRINT " Type eny key : ";
128 COLOR 14,8 : LOCATE 1,1
125 PRINT CHR$(201); STRING$(70,205); CHR$(187);
138 FOR X = 2 TO 23
135
       LOCATE X,1 : PRINT CHR$(186); : LOCATE X,60 : PRINT CHR$(186);
136 NEXT
140 LOCATE 24,1 : PRINT CHR$(200); STRING$(78,205); CHR$(188);
150 LOCATE 1,24 : COLOR 3 : PRINT QUS: : COLOR 7,8
160 TEXTS = STRINGS(20,"-") + QUS
178 'TEXTS - STRINGS(28,196) + "H A K E
180 GOSUB 40000 : LOCATE 14.20 : PRINT "<": : COLOR 10
198 PRINT RTRS;
191 COLOR 7,8 : PRINT ">"; : COLOR 7,8 : PRINT" was typed ";
195 SOUND 788,1
288 GOTO 188
218 '
220 FCOL8 = FCOL8 + 1 : IF FCOL8 > 15 THEN FCOL8 = 6
238 COLOR FCOLS, 8 : LOCATE 4.58 : PRINT FCOLS: : COLOR 7.8
240 BCOL% = BCOL% + 1 : IF BCOL% > 15 THEN BCOL% = 0
250 COLOR BCOL®, 0 : LOCATE 6,50 : PRINT BCOL®; : COLOR 7,0 : RETURN
260 BETHEN 270
278 COLOR 7,8 : LOCATE 8,2 : SOUNO 488,1 : ENO
288 4
290 '
48888 GOTO 48868
40001 '-----
48825 'Csll this subroutine in interpreted BASIC with GOSUB 48888
48018 4
           Requiree : Text to be displayed on line 25 in TEXTS
48015
                       The foreground color in FCOL®.
40020 '
                       The background color in BCOL%.
40025
           Furnishee : The key pressed in RTRS
48838 '
                   by: Nubert C. Borrmenn, (written in August 1987)
```

n Winer Figure 1: A BASIC and assembler routine to provide a scrolling prompt message.

```
40035 '.....
48848 ' The following veriebles ere elso used in this subroutine:
48845 FLAG TEXT TEXTS XS YS ATTRS DLYS
48858 ' Calls the machine lenguage routine : CALL TEXT (ATTR%, TEXT$)
40055 / -----
40060 WHILE FLAG = 0 : FLAG = 1 : DIM TEXT%(30) : RESTORE 48070
48865 FOR X% = 8 TD 55
        READ YS : POKE (VARPTR(TEXTS(#)) + XS), YS
44467 NEVE YE
40070 DATA 6H55, 6H8B, SHEC, SH8B, SH7E, SH08, SH8A
49871 DATA 6H1D, 6H8B, 6H7E, 6H86, 6HB8, 6H58, 6H2A
49875 DATA 6H85, 6HD8, 6HER, 6HRA, 6HDS, 6HRA, 6HSD
48876 DATA 6H32, 6HED, 6H8B, 6H7D, 6H81, 6HB6, 6H1B
40000 DATA 6H51, 6HB7, 6HB0, 6HB4, 6HD2, 6HCD, 6H10
40081 DATA 6H8A, 6H05, 6H89, 6H01, 6H00, 6H84, 6H09
40085 DATA 6HB7, 6H00, 6HCD, 6H10, 6HFE, 6HC2, 6H47
4006 DATA 6H59, 6HE2, 6HE8, 6H5D, 6HCA, 6H04, 6H00
AGGOS MEND
40095 IF TEXTS = "" THEN TEXTS = ".?.?.?.?.?.?.?.?.?.?
40100 TEXTS = RIGHTS(TEXTS, LEN(TEXTS)-1) + LEFTS(TEXTS, 1)
40101 ATTR& - BCDL& * 16 + FCDL&
46185 DEF SEG : TEXT = VARPTR(TEXT%(0)) : CALL TEXT(ATTR%, TEXT$)
40110 RTRS - INKEYS
48111 IF RTRS = "" THEN FOR DLY% = 1 TO 48 : NEXT DLY% : GOTD 48198
                                                           (Figure 1 ends)
```

```
Shows = "This is a scrolling message . . . "
Print "Press a key when you feel like it"
getKey:
   xs = Inkeys
   call Motion(Show$)
   If XS = "" Goto GetKey
   Print "You pressed " Chr$(34) X$ Chr$(34)
Sub Motion(X$) Static
                        'remembers the position between calls
   Static P
   H = Pos(8)
                       'save the current cursor position
   V = CarLin
   L = Len(X$)
   P = P + 1
   If P > L Then P = 1
   Locate 25, 40 - L \ 2
   Print Rights(XS, L - P + 1) Lefts(XS, P - 1):
   x: = Timer
                                  'deley so the scroll isn't too fast
   While X/ + .1 > Timer : Wend 'change .1 for different scroll speeds
   Locate V. H
                                  'restore the cursor position
End Sub
```

Figure 2: A purely BASIC approach to scrolling messages on the screen.

```
/* bytes.c
                                                                                       #define CHECKCOL
    To compile with Microsoft C 4.8/5.8
                                                                                       char buffer(DINVIDTE):
   ol bytes.c
To compile with Microsoft QuickC:
                                                                                       mean()
            cl /oc byteg.c
                                                                                            FILE *fp:
                                                                                             long laccom = #L, freespace = #L;
finelude<stdio.b>
                                                                                                       numfiles = 0;
                                                                                             cher sirestrilfi:
fineludecetype.ho
                                                                                            ificife = stdim:
                                                                                                                                     /* point to etandard in */
#dnfine FILE COL
#dnfine STARTSIES
#define ENDSIES
                                                                                                                                     /* get each line
#define FREEFACE
#define ENDFREE
                                                                                             while; fosts;buffer, sizeof;buffer)-1,fp;;
                                                                                                                                                            (continues)
```

Figure 3: The listing for BYTES.C that determines space used by all the files in a subdirectory.

COUNTING BYTES WITH PIPES

Mr. Rainesh Santhauaut of Portage, Michigan, submitted a program, BYTES, that used pipes to make a DOS DIR command more useful. Mr. Sauthanam wrote that he often faces the problem of having to manually add up the total disk space used by the files in an individual directory. The DOS DIR command displays file sizes and remaining disk space, but not the total accumulated disk space used by all of the files in a directory listing.

His original program presented a complex solution to the problem, which I have simplified here. BYTES, shown in Figure 3, is a filter written in C that reads a directory listing piped to it and prints the accumulated byte count of the files listed.

You can use BYTES by typing

```
DIR | BYTES
```

at the DOS proupt or in a batch file. An example of the output of BYTES is shown in Figure 4

The directory listing produced by BYTES is slightly modified to place the total byte count directly under the byte count for each file. The free space is placed on the next line to keep the display compact.

BYTES uses a DOS "pipe" to get its iuput. As DOS sends the output of the DIR command to BYTES, the program reads each line, looking for directory entries. By checking the character in column 35 (CHECKCOL in the listing; offset from column 0, in C fashion) for a colon, the time-stamp part of a directory listing can be located. When a directory entry is found, the file size in column 12 (START-SIZE) is saved and summed. Then the line is printed just like any normal DIR listing.

```
( tripafer(conces) = -11 / f I then on her ' / f ( then con her ' / f ( then con her ' / f ) en fined on surprise ( then con her ' / f ) en fined on surprise ( then con her ' f ) en fined ( then con her ' f ) en fined ( then con her ' f ) en fined ( then con her ' f ) en fined ( the content of the content
```

```
"s gat free pers number of
buffer(Derrice) = multi-presented;
freepers = stall(married married married
```

(Figure 3 ends)

Figure 4: An example of the output produced by BYTES.EXE.

If the line does not contain a directory entry, BYTES looks for the "File" phrase in column 10 (FILE_COL), an indication that the listing is ending. The number of files and disk free-space numbers are read from the line and printed in the two-line format shown in Figure 4.

BYTES uses the printf(), formattedprint function with the "% 9ld" format string. This forces a total of nine character positions to be used and filled with spaces, ensuring that the columns are lined up. Note that BYTES exects a DIR com-

mand without the /W parameter, which will not provide the file sizes.

—Richard Hale Shaw

TURBO PASCAL

STUFFER CORRECTION

There's an error in the program STUFF-ER, on page 520 of our November 10, 1987, issue. The definition of the variable "buffer" is incorrect. The upper bound of the array and the statement IF tail = should be \$3D, not \$3C. Thanks to Kenneth C. Beaudrie of Denver, Colorado! —Neil J. Rubenkin

ORDER FOR CALCULATIONS

Even though the two expressions in Figure 5 are functionally equivalent, Turbo Pascal will execute the second much faster

```
VAR
CH, CL, DH, DL : byte;
time_in_seconds : real;
(*This way is slower:*)
```

time in seconds := (CH*3600.0)+(CL*60)+DH+(DL/180);
(*This way is faster:*)
time_in_seconds := (CL*60)+DH+(3600.0*CH)+(0.01*DL);

Figure 5: Putting terms in optimal order can speed evaluation of expressions.

than the first for a number of reasons.

First, integer arithmetic executes faster than floating-point arithmetic. In the first expression the floating-point math cornes first, which forces Turbo to do all of the calculations as floating point. By moving the integer arithmetic to the beginning, Turbo can excute part of the calculation in integer arithmetic before switching to floating point.

Second, floating-point multiplication executes much faster than floating-point division. Therefore, instead of dividing by 100 we multiply by 0.01.

Third, the order in which variables and constants are specified makes a difference in speed. Just as it is easier for you to multiply 1,234,567 ib 89 than to multiply 89 by 1,234,567. it is easier for Turbo to evaluate 3600.0°CH than the reverse.

Michael D. Babigian Elk Grove, California

Pating your calculations in optimal order con certainly speed them up, as shown here. However, the most significant optimization you can perform on a Turbo Pascal 3.0 program is to convert it to Version 4.0.1 was amazed at the speed improvement in both of the example expressions. A quick speed check showed TP4 three to six times faster. The optimally ordered exThe most significant optimization you can perform on a Turbo
Pascal 3.0 program is to convert it to Version 4.0.

pression is still faster than the other, but by a smaller margin. And in TP4, it appears that the order of the operands makes no difference.—Neil J. Rubenking

FOR LOOP WARNING

Forcing an exit from a FOR loop by signing the control variable a value generation the test condition is a bad programming practice. Under Turbo Pascal 4.0, its effects are worse than ever. The code in Figure 6 seems to work fine under Turbo Pascal 3.0, but what actually happens is that the loop will repeat ten times no matter what. The assignment is ignored. In 4.0, your program will never get out of loop, it's setting count to 11, making it 12, then back to 11, endlessly. You can see

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LANGUAGES

 It's clear enough—if you need a loop that you can break out of, use a REPEAT or WHILE.

this effect by putting a "WriteLn(count)"

statement inside the loop. Better programming would use While or Repeat loops. For speed, use "Inc (count)" under 4.0 instead of "count := count + 1" in such loops. If you really must force a FOR loop exit under 4.0, set the control variable exactly equal to the test

condition, not beyond. Note that LongInt variables can control a FOR loop in Turbo Pascal 4.0. This is a

```
If short circuit condition exists THEN
count := 11: (<== MECHG:)
         ething important
```

Figure 6: A bad programming practice that's even worse in Turbo Pascal 4.0.

terrific feature! If you use loops like this:

x := 0.0; WHILE x < 1000000.0 do REGIN

some task: x := x + 1.8 END:

rewrite them like this:

FOR x := 1 TO 1888888 DO BEGIN

> some_task; END:

I've found that using LongInt variables is much faster than using any type of real variable.

> Mike Caro Huntington Park, California

The Jensen and Wirth Pascal User Manual says, "The control variable . . . must not be altered by the FOR statement." That's clear enough-if you need a loop that you can break out of, use a REPEAT or WHILE .- Neil J. Rubenking

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PC TUTOR



Avoiding ANSI prompts that lock up your printer; compatibility rules for two-monitor systems; checking whether your drive is ready; printer port address assignments.

My discussion of primer port assignments in the December 8, 1987, issue contained one small but important error. I explained that there are three base port addresses reserved for parallel port devices: 278h, 1978h, and 38Ch. I reversed, however, the order in which those addresses are scanned by the BIOS and assigned as LEPs. The fifth paragraph should have read as follows:

Let's assume you have only one parallet port adapter card, configured to respond to port 378h, installed in your system. That card will be available as printer 1. If you install a second adapter, configured for 278h, your original card will sulbe printer 1. But if the second adapter card you install is configured for 386h, it will become printer 1, and the old card will become printer 2.

My thauks to Autoine Karam, of New Bedford, Massachussetts, for bringing this to my attention. Mr. Karam sent a table that shows the possible combinations of port addresses and their resulting assignments. I've reproduced it here as the table "DOS LPTx Assignments."

MULTIPLE MONITORS

I have an EGA board with an Enhanced Color Display on my IBM PC AT. If I wish to install and drive a second monitor concurrently, what are my choices? Richard G. Estock

Colonia, New Jersey

The rule of thumb is one color and one
monochrome system per computer. In

your case, you can only install a monochrome monitor with a monochrome adapter. Here's why.

The original IBM PC supported simultaneous operation of two display types, a Monochrome Display Adapter (MDA) and a Color Graphics Adapter (CGA). Thus, an MDA driving a monochrome monitor and a CGA driving a color monitor can be installed in a single PC without conflict. This is due to two important factors.

First, the video memory used to store the data that make up the screen images is assigned different physical addresses for the two adapters. The MDA is allocated 32KB, starting at B000-0000. Of that 32KB, starting at B000-0000. Of that 32KB, bowerer, only the first 4KB is used—enough to store one screen of text. The C GA video memory, located at B800-0000, is also allocated 32KB, all of which may be used when operating in graphics modes. The video tnemory is located on the adapters themselves, with the exception of the PCJr, which uses system memory. Adapters whose video memory overlapped would cause both displays to become scrambled.

vecome examinea.
The second important factor is the IIO (inputionput) port address a which the CPU communicacy with the two dapter types. Devices in the PC use IIO ports agained syst brough which data and rinstructions pass as they travel to and from the CPU. Like memory locations, ports are identified by an address. The video subsystems are allocated parts 3B(th) to 3BFh for monochrome and ports 3D(th) to 3DFh for monochrome and ports 3D(th) to 3DFh for

The Enhanced Graphics Adapter (EGA) can be configured (using DIP

DOS LPTx Assignments

rinter name assigned by DOS



Port address combinations

This table can be used to determine the LPTx designation that DOS will assign to any combination of parallel port devices. Find the row that lists the ports installed; the column heading will show the device name above each port address.

Although the EGA can be configured to respond as a monochrome or color board, two EGAs cannot be in a single system.

switches on the card) to act as a color or monochrome display card. The setting of the DIP switches determines to which port and video memory addresses the card will respond. The EGA can therefore be substituted for one of the other cards as long as the monitor type (color or monochrome) remains the same.

Although the EGA can be configured to respond as either a monochrome or color

board, two EGAs cannot be installed in a single system. This is because, in addition to the assigned ports, the EGA uses ports in the range from 3C0h to 3CFh. Thus, two EGA systems in the same PC would conflict. The EGA card does contain a iumper to move the card addressing from 3xx to 2xx, but no current BIOS supports this alternate addressing.

The following table illustrates your choices. Primary Secondary

MDA CGA or EGA/color CGA MDA or EGA/mono EGA/color MDA EGA/mono CGA

CHECKING DISK STATUS How can a batch file determine whether the A: drive door is open? Or, more to the point, whether a disk is installed and ready? Can you provide a utility which sets DOS's FRRORI EVEL so that a batch file can decide whether to try to read/write files on a floppy drive?

Dan Glisson Boston, Massachusetts

It's really a shame that DOS doesn't provide a full-featured batch language for creating more-intelligent batch files. However, as you suggest, ERRORLEVEL can make up for at least some of DOS's shortcomings. Figure 1 shown on the following page lists a short program you can create with DEBUG that will return the status of any disk drive in your system.

To create the program DSKREADY .COM, make sure DEBUG is in your current directory or in a directory accessed by your PATH command. Then, simply start DEBUG, and type in the instructions exactly as shown in Figure 1. Be sure to include the blank line-just an <Enter>-just before the RCX command. To

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■ PC TUTOR



Figure 1: A program to include in .BAT files to check the status of a disk drive.

use the progrom, just put the line DSKREADY d:

in your batch file, where d: is the drive you wish to test.

Much of the function of DSKREADY depends on some nice little extras that DOS performs for us whenever it loads a progrom. For exomple, if the first orgument ofter the program name contains a drive specifier, DOS will check to see if it is valid. If not, the AL register is set to FFh. If the drive letter is valid, AL will be

DSKREADY ERRORLEVEL Codes

2 255

is used.

Disk is ready Drive not ready (No disk or door open neral fallure (Disk not formatted) Drive does not exist

zero, ond the number of the drive (A=1,etc.) will be stored of offset 5Ch in the PSP, the stort of the first File Control Block (FCB). If a second argument is present and contoins o drive specifier, the action is the some except the AH register is

used and the second FCR located at 6Ch If an invalid drive is specified. DSKREADY will return with ERRORLE- VEL set to 255. If the drive is valid, the DSKREADY.COM program attempts to read a sector from the drive in question. Unlike the other DOS functions, INT 25h ond INT 26h don't generote the "Abort, Retry, Ignore?" message when o disk error occurs. Instead, they return error codes directly to the colling program. These error codes are then passed to the batch file when DSKREADY terminotes. The toble "DSKREADY ERRORLEVEL Codes" lists the values returned by DSKREADY and the meanings associated with them.

PROBLEMS WITH ANSI PROMPTS I use the ANSLSYS driver to add color to my screen by using the following PROMPT command:

PROMPT Se(31:48:mSnSqSe(32:48m

This gives me a red "A>" and green text. I have placed this command in my AU-TOEXEC BAT file to automatically load it each time I start my computer. Now for the catch. Whenever I issue a

Ctrl-PrtSc command to echo screen output to the printer, normal output (e.g., a DIR listing) prints just fine. But when the prompt reappears, the printer locks up and will not take another command until you cycle the power or reboot the computer. The printer works fine as long as I do not issue a PROMPT command with the \$e[string in it. All the promots that are listed in the DOS manual work fine. Can you explain this?

James Hodges Palmersville, Tennessee

This is one of those problems that can be very aggrovating. The Ctrl-PrtSc function (which can also be toggled with Ctrl-P) causes every character that is sent to the screen using a DOS function to also be sent to the printer. This is great for logging DOS or DEBUG sessions.

The ANSI, SYS driver con be used for screen and keyboard control at the DOS level. Instructions are passed to ANSI by including them in the output stream prefoced by the sequence ESCI. When ANSI sees these two charocters, it interprets the following characters os instructions. A populor way to pass commands to ANSI is vio the prompt command. When doing so, the ESC charocter is represented by \$e. Unfortunately, most printers olso use the ESC charocter to signal instructions. so if your prompt has o Se in it, and Ctrl-PriSc is on, the possibility of conflict exists. The ESC and following characters will be sent to the printer, possibly causing

 Unfortunately, most printers use the ESC character, so if your prompt has a \$e and Ctrl-PrtSc is on, the possibility of conflict exists.

it to go into o different mode, shut down, or signal back an error ond woit for o reset code. A lot of stopgap measures could be im-

plemented, like filtering all ESC codes out of the printer stream, but then legitimate instructions couldn't get through. So, unfortunately, the simplest solution is to give up either the Se in your prompt command or Ctrl-PrtSc. If, however, you con live with partial color and the inconvenience of having to occosionally run o batch file to re-color your screen, you con split your prompt into two parts, thus:

PROMPT \$e[31;48;m PROMPT SpSq

The first line sets the screen color, and the second sets o normal prompt. Put both lines in o batch file ond run it whenever you need color.

ASK THE PC TUTOR

The PC Tutor solves practical problems and explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to PC Tutor, PC Mogazine, One Park Avenue, New York, NY 10016. We're sorry, but we cannot answer questions personally.

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Downloading files from the IBM System/36 to a PC; problems with running a Novell server using DOS 3.2; lowering the cost of networking without sacrificing IBM compatibility.

SYSTEM/36 FILE TRANSFER

Transferring data from the popular IBM System/36 minicomputer isn't always easy. Here Thomas Lewis offers insight and hints on the process.

In your cepty to Vivek Chanmagan in the December 22 issue regarding downloading of data files from the IBM System/50 to a PC, you may have missed the actual question. I think the key to the question is the word packed, in this case, the word is the word packed, in this case, the word is values in such a way as to user oughly half the normal space. This is done by climinating the "zone" nibble thatf-byto from numeric items and compressing the data to two digits per type. The sign is carried to the property of the property

The problem with such data is that EBC-DIC-to-ASCII conversion can yield some strange results because such data is not clean EBCDIC to start with. Since the technique is widely used for numeric items in both the IBM mainframe (S/370) and mini (S/3X) worlds, it is common for a special extraction program to "unpack" and insert decimals and signs in the data prior to downloading and translation.

I don't recommend it, but since your correspondent is forced to rekey from printed reports, it is possible to download a report from the System/36 using the following steps:

 Print the report on the System/36, placing the output on hold in the print spool (use PRIORITY-0 in the printer statement for automatic hold). Use the COPYPRT procedure to copy the spool entry to a file; then you can release the report to print or cancel it via this procedure.

3. Download the resulting file. It will contain a header record and some formating information at the beginning of each record (print line). The records will be the report lines themselves, including heading lines and spaces between fields. It's not pretty, but this technique can be useful.

If this method doesn't work, your correspondent will have to convince his programmer to develop an extract program to write the needed data with delimiters, signs, and decimals.

Thomas Lewis Clinton, Mississippi

ECONOMICAL IBM COMPATIBILITY
We certainly enjoy your column and subscribe to PC Magazine for that reason.
Here are our questions: We are installing

 A hub is not required for the IBM PC
 Network Baseband
 Adapter, whose cards and wiring help keep costs low. IBM Doctor's Office Manager software under the IBM Token-Ring Network with IBM hardware without a dedicated file server and with only one or two other ATs added as nodes. How much speed improvement would a dedicated file server give? Are there other, more-conomical ways to boost the speed? Are there economical ways to lower networking costs and still retain tight IBM compatibility?

Also, we would like to bandle TSR pro-

grams but always run out of room. How can we tell how much memory is available?

A. Colin Flood Goffstown, New Hampshire

Aboays nice to heart from a fain, Mr. Flood. Taking your questions in order, you must decide how much work you plan to do locally on the file server. Since you will have only about 170K RAM free glot PC Local Area Network. Program loads all of the server modules on this machine, there isn't to much you can do The speed improvement you should expect from a dedicard or the speed improvement you should expect from a dedicard or all several control of the speed improvement you should expect from a dedicard or old seyurder, and this arrivity requests take the attention of the server away from the network.

Frankly, the best way to keep a network responsive is not to use it. If applications can reside on the AT workstations, then store and use them there. Save the network for networked tasks.

You certainly can lower the cost of networking by choosing the IBM PC Network Baseband Adapter instead of the IBM Token-Ring Network adapters and

■ CONNECTIVITY CLINIC

Multistation Access Unit. This little-known IBM network alternative is not the same as the IRM PC Network broadband network originally made by Sytek. The IBM/Sytek system is a broadband coaxial cable sys-

tem. The Baseband Adapter is a StarLANtype system running over unshielded twisted-pair wiring. A hub is not required. The cards and wiring all keep costs low. Technically, the throughput of this system is

 We regularly experience problems with DOS 3 3 in disk format activities.

less than that of the Token-Ring, but I don't think you'll see a practical difference in performance. We have a full review of the Network Baseband Adapter scheduled. but, as far as it's possible to predict in advance. I think you'll be happy with it.

The simplest way to tell how much RAM is left is to run CHKDSK. The networking software won't let you run CHKDSK on a networked drive, but running it on any local drive will show you the free RAM.

DOS INCONSISTENCIES

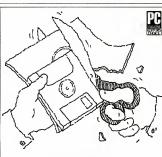
We run an IBM Token-Ring Network using Novell software and an IBM PC AT file server. When we set up our system, we did not create a DOS partition on the server's drives.

Subsequently we added an AST Turbo-Laser printer to the file server. The AST printer's interface board is installed in the file server and is initialized with a DOS program before NetWare is loaded. We did not want to reformat our drives, so we decided to boot from a floppy disk

We had been running DOS 3.2 on the workstations without a problem, but when we tried to boot the file server from a floppy disk using DOS 3.2, we were able to accomplish it only about one time out of five or six tries. After many attempts to solve the problem and several calls to Novell, it was suggested we try DOS 3.1. That cured the problem. There seems to be something in DOS 3.2 that doesn't quite click with Novell.

> Floyd Petersen Loma Linda California

I printed your letter, Mr. Petersen, because I've heard rumors of this incompatibility before. However, I walked into the Connectivity Lahs and booted our Novell server (an 8-MHz IBM PC AT) under IBM



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PC-DOS 3.2 ten times without a problem. I assume you tried different DOS 3.2 boot diskettes to eliminate incompatibilities between drive and diskette? Have any other readers had problems running a Novell server under DOS 3.2?

I will add that we regularly experience problems with DOS 3.3 in disk format activities. Our machines stay loaded with PC-DOS 3.1

PC LAN FORM-FEED CORRECTED

We have had several rounds of comments discussing the waste of printed forms caused by the sometimes unwanted final form feeds in IBM's PC Local Area Network Program. Here is the answer.

IBM has just made available an update for its PC LAN Program, called Version 1.23. It has an option on the Net Share command to prevent forms from being wasted with

■ PC LAN Program's update prevents forms from being wasted with end-of-job page ejects.

end-of-job page ejects. Contact your IBM rep and ask for Item 072MD, the latest version of *PCLP*. Ask for it in 3½- or 5¼-inch disk sizes, as needed.

Michael W. Butler Concord, California

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Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, plus an extra \$25 if you submit your letter on a disk, and we'll gladly answer any questions you have, at no charge. We're sorry, but we're unable to answer letters personally.

Mail your contributions to Connectivity Clinic, PC Magazine, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named CONNECTIVITY CLINIC).

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HOW TO SUCCESSFULLY BUY THROUGH MAIL ORDER AND PROTECT YOUR RIGHTS

Mail order sales are governed by rules of the Federal Trade Commission (FTC) and various state laws. These guidelines are published as a service to you. Remember, the many vendors advertising in PC Magazine are eager to serve your needs.

FTC rules say: 1. The Seller must ship your order within 30 days of receiving it, unless the advertisement clearly states it'll take longer. 2. If it appears that your order will not be shipped when promised, the Seller must notify you in writing in advance of the promised date, giving a definite new date, if known, and offering you the opportunity to cancel the order with a refund or consent to a definite delayed shipping date or an indefinite

3. The Seller's notice must contain a stamped selfaddressed card or envelope with which you can indicate your preference. If you don't respond to this notice, the Seller may assume you agree to the delay, but must either ship or cancel your order within 30 days after the original required. A prompt refund must be made when an order is cancelled. 4. Even if you've consented to an indefinite delay, you retain the right to cancel the order at any time before the item has been shipped. 5. If you choose to cancel an order, that has been paid for by check or money order, the Seller must mail you a refund within seven business days, If you cancel an order for which you paid by credit card, the seller must credit vour account within one billing cycle following receipt of your request. Store credits or vouchers in place of a refund are not acceptable. In the event that the item vou ordered is unavailable, the Seller may not send you substitute merchandise without your express consent.

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TIPS WHEN ORDERING When ordering by mail: State precisely what merchandise you want, specifying details such as model, make, size, component parts,

Confirm the price and expected delivery date as stated in the ad; Indicate whether you will accept a substitute product if

the item you ordered is unavailable, and, if not, that your payment should be returned; Don't send cash, you will

have no record of payment if a problem arises, and; Keep a copy of your order and all other correspondence with the Seller. Nour records should include the company's name, address and phone number; a description of the item ordered; your cancelled cheek or a copy of the money order, record of the date you maided the order; and any sales slips and shipping receipts.

When ordering by phone: Note the time and date of your conversation and the name of the person you talk with;

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With whom should you correspond if there is a problem?

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copy of the letter.
2. If you complain by telephone, send a follow-up letter to confirm what was said.
3. If you think the merchandise is defective, neread your product instructions and your warranty carefully to be sure you don't expect features or performance the product instructions. Don't return it to the Seller until you have been

instructed to do so. 4. When returning merchandise make sure you keep the shipper's receipt or packing slip; your right to be reimbursed for postal cost is determined by store policy. 5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

PC Magazine's Direct Marketing Connection For PC Products



*Starch Study, July 1986

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The 80286 Test Results PC Magazine Did Not Show Its Readers...

Northgate Computer's Throughput Was Fastest of All Systems Tested!

PC Magazine's Feb. 16, 1988 issue reviewed Northgate's 80286 System and 20 others.

PC Labs performed throughput tests on all systems as well as the standard disk performance tests.

Throughput tests performed by PC Labs confirmed Northgate equals or outperforms systems using drives with as fast as 28MS head access

Unfortunately for Northgate, the editors did not report on throughput performance, but only on hard drive access.

(ÍN CASE A DEFINITION OF THROUGHPUT IS NEEDED— IT IS THE SPEED AT WHICH DATA GETS BACK AND FORTH BETWEEN DRIVES AND THE PROCESSOR)

Truth is, throughput is the real world of computing. Head access speed is relatively meaningless.

In their comments on the

Northgate System, they also stated that Northgate's RLL encoding of the drives and the 1:1 interleaving had no effect on hard drive access.

Northgate has never made a claim about improving head access with these methods. IN-STEAD, BY USING ADVANCED HARD DRIVE TECHNOLOGY, NORTHGATE DELIVERS THROUGHPUT PERFORMANCE TO EQUAL OR SUPPASS PERFORMANCE OF SYSTEMS USING FASTER, MORE EXPENSIVE HARD DRIVES.

The bottom line for the consumer is Northgate gives You More Computer For Your Money!

Northgate pioneered the technology that enables us to design systems using low-cost (but highly reliable) hard drives and enhancing their performance to yield real-time computer performance as good or better than

systems using far costlier drives. Frankly it hurt us to see the conclusions reached by PC Magazine based on PC Labs' testing. But...Northgate has been fully vindicated by the magazine's recognition of our toprated throughput performance.

More importantly, the buying public now has meaningful results on which to base a purchasing decision.

A careful study of features, price and performance of all systems reviewed in that issue will prove to you that Northgate is the overall Best Buy!

Northgate was the first to offer RLL, 1:1 interleaving and



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If you want to really have your eyes opened, call our competitors, large and small and ask if you can get a hard drive with these features. You'll be shocked. Try it.

NOW FOR SOME REALLY GOOD NEWS...

Northgate's Enhanced Technology leaps ahead and totally eliminates any question of head

On all Northgate 80286 and 80386 Systems currently shipping, we include a Disk Caching program at no extra cost. Using this highly efficient Disk Caching, once a file is read into memory, sawing or reaccessing it requires zero disk access. Much like a RAM disk. But unilke a RAM disk data is sawed when exiting the

applications program. MOREGOODNEWS...Northgate now includes the superb VOPT Disk Optimizer developed by Golden Bow Systems. installed in the Autoexec bat of your computer, each time you turn on your system. VOPT goes to work re-organizing your hard drive to keep it running efficiently. Another Northgate First!

CONCLUSION...

For Complete Computer Systems on the Cutting Edge of Today's Technology, phone all the others, then call Northgate. We believe it will be the last call you'll need to make!



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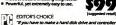
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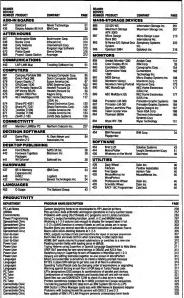
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EDITORIAL PRODUCT INDEX



COMING UP

INEXPENSIVE DTP All businesses publish everything from newsletters to presentations to letters. So it's not surprising that a wide variety of desktop publishing packages-which help people get the job done faster, smarter, and better (without any need for T squares, scissors, or glue)-have found a market. Lately, the market has been besieged by low-eost products promising professional results at a savings of both time and money. We review six of these \$80-to-\$500 packages, including Byline, GEM Desktop Publisher, and PFS:First Publisher, to find out whether it's possible to get more than you paid for.

OS2: THE WAVE OF THE FUTURE Four years after the arrival of the AT, we finally have an operating system that can take full advantage of it. At long last OS/2 is here! And it has the potential to spur programmers on to create whole new breeds of application software for the PC. Charles Petzold examines this system for what it is now, what it does, and what it will become (including a peck at scheduled upgrades such as the Presentation Manages).

PROJECT DATABASE. The first Procipe To Bathase in 1984 was the granddady of all of PC Magazine's special "blockcope of the property of the property of the prospect of the property of the property of the prospect of the property of the property of the prospect of the property of the property of the programs, followed by relational packages, then by elabiding produces that are also here by elabiding produces that are also size up 24 flat-file databases to see how sophisticated and easy to use they really are, and whether the gap between these products and high-end relational programs has constructed the property of the property of the protess and high-end relational programs has the property of the property of the property of the protess and high-end relational programs has the property of the property of the property of the protess of the property of the property of the protess of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the protess of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the property of the protess of the property of the property of the property of the protess of the property of the protess of the property of the proper

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Bible Studies: Two Programs That Can Help Find the Answers

BY DONALD B. TRIVETTE
The King James Version of the Bible is the most widely read and studied Christian ext in hispatical control of the Bible is the most widely read printed editions occurred to the printed edition occurred to the Bible printed to the Bible pr

Gad Sneed can find any word or phrase in the 66 books of the Bible in less than 3 seconds. Compare that with as long as 30 minutes for some programs. It's distributed on seven 51/4-inch floppy disks and requires a hard disk, although a \$27 New-Testament-only version can be run from a floppydisk-based system. The installation procedure copies the data to a hard disk and compresses the 4.3 million bytes of text in the King James Bible to one relatively compact 2.4MB file.

The key to God Speed's

speed is its custom indexing scheme designed specifically for the Bible. Since the index is integrated with the data, there is no delay in loading additional files, and the first search may be made within seconds of loading the program. But this method trades precision for speed, and words are located only within verse boundaries. For example, type the phrase "eye for an eve," and God Speed finds two occurrences. The first is Matthew chanter 5, verse 38, and is indeed the familiar quotation: "An eye for an eye, and a tooth

for a tooth." The second occurrence is in 1 Corinthians 15:52; it's not the quotation we had in mind, but it does happen to contain the three words "eye," "for," and "an" in a different order than we had specified. The Map command pro-

duces a distribution and occurrence table for any word or phrase. The word "love," for example, occurs 310 times in 280 verses. It appears 23 times in Psalms, 23 times in John. God Speed has the simplest

user interface of any program I've tested. A menu bar across the top of the sereen presents four choices: Help, Find, Map, and Exit. Press F for Find and then type the word or phrase. The verses appear almost instanly with the search words highlighted in blue, and the words of Jesus displayed in red

And the first and the second s

Ged Speed's interface is exinterface is extremely simple. Although lacking precision in specifiing search lerms, it does not usually cause problems.

if that option was selected when God Speed was loaded. Even Methuselah wouldn't have difficulty running this program.

Bookmaster Bible is distributed on six disks. Because it uses a separate file for the index as well as for each book of the Bible, it may be run from a flopyr-disk-based computer, although performance is significantly degraded. Even when run from a hard disk, it takes 30 secoods for Bookmaster to read the 162,000-byte index file into memory before the program can beein.

begin.

Boolsmanter is the flip side of
the coin: it trades speed for precision. Enter the phrase "type
for an eye," and the software
locates just the one occurrence,
in Matthew 5:38; but it takes 5
minutes to slog its way through
36,000 lines of text on an IBM
952 Model 30, Searching for a
single word is considerably faster and more centertaining. Type
"ye," "for example, and a table
is dissibated on the rish side of the
sideslawed on the rish side of the
sideslawed on the rish side of the

"eye." for example, and a table is displayed on the right side of the screen showing that "eye" appears 116 times, "eye-brows" once, "eyelids" 6 times, and so forth.

A full range of search options may be used, including multiple search terms, case-sensitive terms, words, phrases, and words within proximity of other words. The seholarly user is able to insert and retain footnotes and annotations within the text; searches may then be conducted on the Bible. the foot-

notes, or the merged text.
With all these features.

you'd think Bookmaster would have a thick manual filled with examples. It doesn't. The 25page pamphlet does little more than explain the uses of the function, alternate, and control keys. With software as sophisticated as Bookmaster, that's a near-fatal flaw. Even Solotus

would be puzzled. Of course, search software is only as good as its data, and noither God Speed not Bookmaster includes the Apocrypha in its text. The Apocrypha are an additional 14 or 15 books that were included in the original King James Bible as an appendix. Although few of today's printed Bibles contain the missing books, they are historically important and should be included in any product aimed at scholars and theologians List Price: God Speed, \$100

Requires: 256K RAM, hard disk drive with 2.5MB free, DOS 2.1 or later. Not copy protected. Kingdom Age Software, 3368 Governor Dr., Suite F-197, San Diego, CA 92122; (619) 586-1082.

CRCLE 666 ON READER SERVICE CARD List Price: Bookmaster Bible. \$295. Requires: 640K RAM, hard disk drive with 2MB free recommended, DOS 2.1 or later. Not cope protected. Bookmaster Corn., P.O.

Box 2396, Telluride, CO 81435; e (619) 247-5183.

Bookmaster Bible has a wide variety of search modes that enable the user to zero in on specific quotations. Colorful help curds can be popped up at aux time.





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rogect: Space Station requires cureful, prudent planning but also offers action screens like this launch simulation.



Putting NASA Back On Track for Only \$29.95

BY IONATHAN MATZKIN Things are pretty bad for NASA lately. The agency suffers one launch disaster after another, while the Soviets buzz merrily along with their space station program. Some pundits even say that Uncle Sam has lost his

lead in the space race. Project: Space Station, from Avantage, is intended for armchair administrators who think they could manage America's space program back to its world-leading role. The game simulates the decisions and actions involved in creating and maintaining a manned U.S. space station. You are challenged to fund, staff, and manage a program that will put Americans in orbit on an ongoing basis.

The heart of Project: Space Station is planning. Missions can't be conducted without an approved plan, and even acceptable plans can go astray.

You must not only conserve the funds that you start out with but also generate income for your space program by conducting profitable R&D projects in space. Among other things, that means hiring the appropriate personnel, assigning them to space shuttle flights, and acquiring the necessary equip-

ment to conduct your research. The documentation warns that a single Project: Space Station game can take days or weeks. There are seemingly endless details and problems that you must cope with on your way to a place in the history of space travel.

Which is not to say that Project: Space Station lacks action. You design your space station on-screen by combining various living, working, and support modules. The graphics for space shuttle launch and landing are exciting to watch, though your participation is limited to simple actions to keep the ship

on course

Project: Space Station's most engrossing screen is a representation of the space station in orbit. You can maneuver around in small space pods and do work outside the station. This screen looks a bit like traditional arcade games like Defender or Zaxxon.

Unfortunately, the documentation for Project: Space Station is sparse and occasionally misleading. In working through the extensive tutorials, I sometimes had to ignore the manual to figure out what to do rebral game of chess to a quick run at Lode Runner. Project: Space Station could be just the obsession for you.

List Price: Project: Space Station, \$29.95. Requires: 256K RAM. one disk drive. CGA or Hercules graphics adapter DOS 2 flor later Not copy protected. Avantage, 29813 Stevens Creek Blvd., Cupertino, CA 95014; (408) 446-

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A Daily Dose of Wit At a Bargain Price

BY JARED TAYLOR

Do you like those little calendars that start your day with a quotation or a new vocabulary word? Do you enjoy testing your wits with trivia questions? If you do, Daily Features, by Channelmark Corp., could be the program you'd like to see first when you turn your computer on in the morning

You can install Daily Features as a TSR, but the obvious way to run it is as a standalone from your AUTOEXEC.BAT file. Every day of the year, it presents you with a quotation, a new vocabulary word, and a trivia question. To make things more fun, the program is a knowledge test. The question appears without an answer, the quote without its author, and the word without a definition. If you're stumped, a single keystroke gives you the answer. The vocabulary and the trivia questions are only medium hard, but you'd have to be a whiz to guess the authors of most of the quotes.

The program comes with a year's worth of features, but you can start using the program any day of the year. You can page backward through the calendar to see features from past days, but the program won't let you page forward. After 365 days the features repeat themselves.

Channelmark can supply you with new features for a new year, or if you like, you can make your own. The program comes with a utility that converts ASCII data into databases that work just like the ones Daih Features comes with. This means you can make your own lists of questions, vocabulary words, daily reminders, or riddles for your own use or to entertain others

At \$14.95, Daily Features sets some kind of record for inexpensive software.

List Price: Daily Features \$14.95. Requires: 256K RAM, one disk drive, DOS 2.0 or later. Not copy protected. Channelmark Corp., 2929 Campus Dr., San Mateo, CA 94403; (800) 851-2917, (800) 223-1479 (in Calif.).

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The Leading Role in a Spy Thriller: Border Zone Presents Three Possible Missions

BY GUS VENDITTO Interactive fiction has taken more than its share of knocks. Legions of the curious have tried a game or two, only to emerge from their adventures cursing and frustrated. The games didn't understand the language of the uninitiated, and so the uninitiated staved that

Maybe this failure to communicate owes more to the subject of those games than the logic needed to understand them.

That logic is not beyond most people. These games present threatening situations and invite you to save yourself by barking out commands to the game. Deducing each game's quirky reasoning is simply a matter of patience: try anything. but learn from your mistakes.

Until now, interactive fiction has grown under the blanket of fantasy and science fiction. Star Trek and other space iaunts have lent their mystiques to "destroy-the-alien" adventures: The Lurking Horror about 80 percent of the hints that

treads through H. P. Lovecraft's dark territory; and Zork dwells in damp dungeons haunted by wizards and elves.

Everyone enjoys a good story, but many of us are unwilling to venture into a land of dungeons and dragons, no matter how many thrills await.

Border Zone, from Infocom, has hit upon exactly the right scenario for an interactive novel: an Eastern European espionage nest. You deliver secret documents in clandestine meetings and then get out of the country, while the police hover nearby. The rules are familiar only to those who grew up with James Bond and "Mission Impossible": for example, trust no one, never say more than you have to, and be ready to make a quick exit

It was written by Marc Blank (which has got to be a nom de keyboard), the author of Zork. If you're going to read a spy novel, it might as well be one of John Le Carre's, and if you're going to try interactive fiction, you might as well start with

Several hours after I boarded the train in Border Zone's Frobnia. I solved my first challenge: sneaking a document past machine-gun-toting police and passing it on to a Russian double agent. ProKey helped cut down on repetitive typing ("Walk North" "Walk South"), I used

Marc Blank's latest.

"Ouzna Gotcha" and Other Required Phrases

Border Zone does not require proficiency in Frobnian (the language of the fictitious Eastern bloc state where Border Zone takes place), but "I Am Frobnia: Fortunate Tourists Guide and Phrasebook" is one of the game's delights. Among other tips, it reports that there is no translation for "Please" or "You're welcome." Practice dialogue sessions usually conclude with Ouzna eotcha ("You're under arrest").

Hello Pimsna My name is . . . Riza yorp . . . l am from . . . Intz kem . Where are you from? Kap kladni? What is your . . . Snim pli . . . blood type? corpzim? age? heriznip? potato ration? viski huritz?

Corwight 1917 Infocus Inc.: retrieted with per

the game reluctantly divulges, started to rely on the deep pool of sneaky habits I had acquired as a youth but thought were now in remission, and became completely absorbed. Two more chanters were waiting

The hints are another reason why Border Zone may appeal to many who have shunned interactive fiction. You don't have to pay extra for clues to the name's logic, just type Hints from the command line, and then repeat your request even after the game takes a parental attitude and tries to warn you off. On-line hints are long overdue in interactive fiction, and this ought to

he the beginning of a trend. With the first of three legs complete, it's a good time to take in the game's printed matter: the lavishly illustrated pamphlet "I Am Frobnia: Fortunate Tourists Guide and Phrasebook" (see sidebar ""Ouzna Gotcha' and Other Required Phrases"); a map of the terrain near the border; an ornate business card from a local merchant; and a matchbook, compliments of Frobnia's railway (if we can deduce anything about the railway service from the quality of the matches, expect your train

to be delayed). The rich detail in these souvenirs adds to the interactive feeling. Only the map proves useful (in chapter 2), but the phrasebook enriches the atmosphere. It gives Border Zone a sense of mission, unlike other games where you sometimes wonder if anybody, other than

the head programmer, ever really knew what was going on. Chapter 2 creates a good chase that rises to edge-of-yourseat urgency at the climax. You'll need total concentration to elude the beams of the three searchlights that constitute one

of the final bundles at the Frobnian border You play different roles in each chapter, and since your goals in the first two are straightforward, you'll hardly care. But chapter 3 is full of plot twists and double agents. I felt a little cheated that the work I had done in the first two chapters

wouldn't help here. But, hey, the life of a spy is thankless. Your only satisfaction comes when a mission is accomplished. And when your

logic is understood. List Price: Border Zone, \$39.95. Requires: 192K RAM, one disk drive, DOS 2.0 or later. Not copy protected. Infocom Inc., 125 Cambridge Park Dr., Cambridge. MA 02140; (800) 262-6868.

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Be Careful Out There: Police Quest Plays It by the Book

BY NEIL J. RUBENKING
Did you think that computer adventure games were strictly for fantasy and science-fiction buffs? Does bashing monsters and scaling treasures leave you cold? Perhaps you'd rather read Mickey Spillane than Isaac Asimov? Then look at this—Sierra Online has created a computer adventure game for you.

If you can manage to keep your cool and follow proper procedure—for instance, when writing a traffic ticket for a ravishing brunette (the game aims

to simulate all aspects of police behavior, from locker-room humor to male-chauvinist prejudices), you'll advance to moredifficult situations. Eventually you'll go undercover to break the drug ring that's poisoning Lytton's youth, by confronting the much-dreaded "Death Angel" himself.

The game comes with a street map of Lytton and a Policeman's Indoctrination Guide (P.I.G.). This guide is the Police Quest player's bible; all the police procedures you need are laid out in the P.I.G., and you must follow them exactly to succeed. Caught a car thief? Ouick, check the Felony Traffic Stop Procedures and follow the six steps (which include calling for backup and ordering the suspect to "lie facedown on the ground"). If you omit steps or make a mistake (like being late for morning briefing), you have

to start over Unlike other adventure games, Police Quest has a plot that proceeds with the passing of time. Often you simply cruise in your patrol car waiting for something to happen. You gain points by following proper procedures in handling the situations that come up. If you make a major blunder, like letting a prisoner grab your gun, you'll die and will have to start a new game to get another chance. However, you can fail in minor ways and merely lose points. As a result, it's possible to play and replay Police Quest-trying to get all the possible points. Only by following your guidebook to the letter will you be able to get



You use a combination of joistick of cursor movements and typed communits partial sour heat in Police Quest

the maximum score. Police Quest ships on three 5½-inch floppies and two 3½-inch floppies and two 3½-inch floppies, a nice touch for all those officers who will be partolling their beats with PS2s. And, in a move we host own practice, Sterra Online is shipping Police Quest and two other new games of the property of t

Adventure games are becoming more and more like interactive movies. Now that some game companies are breaking out of the science-fiction/fantasy mold, we can expect even greater variety in their scope of subject matter.

Police Quest is great fun for people who'd enjoy the fantasy of being cop for a day. Stay away if you're offended by off-color humor. But if you're dis-

color humor. But if you're disappointed by the CGA-level graphics in most PC games, check out this game on an EGA or VGA to see state-of-the-art PC animation.

List Price: Police Quest, \$49.95. Requires: 256K RAM, one disk drive, graphics adapter (EGA, CGA, Hercules, VGA, MCGA; EGA or better recommended). DOS 2.0 or later. Not copy protected: Sierra Online: P.O. Box

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AFTER HOURS

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Dragnet Comes to the Small Screen

The city: Lytton, California. It's a peaceful town, a fictitious place, created by Sierra Online for Police Quest. It's much like any other small California town. In fact, it's very much like the town where Jim Walls patrolled for 15 vears.

He's retired now, but recently Walls sat down with two programmers and mapped out a story line for Police Quest. He filled in the dialogue and spelled out the proper procedures and regulations followed by police officers everywhere. The idea was to recreate the environment of a small-town police force.

Walls agreed to pose for a photograph for the game's cover, it he wouldn't reveal the town where he wore his badge. Protecting the innocent, of course.—Gus Venditto

Work like this doesn't just happen.

LKXS RADIOGRAPHY OPERATING GROUP Review of Operations

During 1987, the LKXS radiography companies preused forward vigorously with a stress of product introductions and sastheting programs designed to transform LIXS into a "new busines" girded for continued growth in both the increasingly compositive U.S. bitectstoology field and the energing bioexchanlage market weed/business.

Profits Up in Growth Year

Throughout 1987, employees worked diagnally to improve current product quality, control operating costs, and provide outstanding costs and provide outstanding costs on the cost of the co



To foster continued growth in overseas markets, we opened subsidiaries in Japan and Hong Kong. These contributes have already paid off with international sales accounting for 7% of total resource. Nest year, we expect a strong showing as these substitution continue to

showing as these subsidiaries continue establish thomselves.

1987 Revenues by Aren						
(Doll	ers in millio	m)				
REGION	ANOUNT	PERCENT				
Northerst	\$ 3433	35%				
Midwest.	\$ 2885	29%				
New York	\$ 1094	11%				
New England	\$ 1095	11%				
Southwost	\$ 713	7%				
for1	\$ 633	2%				
TOTAL	\$9546	100%				

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NR² at major conferences in the field, both in the United States and overseas, to an

Review of Operations

page 1

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